

16

ARCHIVES OF OTOLOGY

EDITED IN ENGLISH AND GERMAN

BY

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ARCHIVES OF OTOLOGY.

ON THE SIGNIFICANCE OF THE DEVELOPMENT OF OPTIC NEURITIS IN CASES OF PURULENT INFLAMMATION OF THE MIDDLE EAR.

By CHARLES J. KIPP.

DURING the five years that have passed since I published in THESE ARCHIVES (vol. viii., p. 147) four cases of purulent inflammation of the middle ear in which optic neuritis was present, I have made frequent examinations of the eyes in nearly all cases of suppuration of the middle ear that have been under my care.

Briefly summarized the results obtained were as follows.

Optic neuritis was found in only a very small proportion of all the cases examined. In the majority of cases with optic neuritis well-marked symptoms of meningitis or abscess of the brain, such as fever, persistent and severe headache, vomiting, delirium, drowsiness, stupor, convulsions, hemiplegia, or paralysis of ocular muscles, were present either at the time the optic neuritis first showed itself or came on soon afterward.

In a few cases persistent headache and occasional nausea or vomiting were the only symptoms pointing to a cerebral complication present during the whole course of the ear affection.

Optic neuritis was observed only in cases of otorrhœa of long standing.

In some there was manifest disease of the mastoid cells, but in most cases the mastoid region was neither red, swollen, nor tender on pressure. More or less swelling of the wall of the external canal, perforation of the drum membrane, polypoid granulations, and swelling of the lining membrane of the tympanic cavity were present in all.

Caries of the external canal and of the tympanic cavity could be discovered in many of the cases.

The patients were nearly all adults.

A fatal termination occurred in somewhat more than half of the cases. Most of these came under my observation only a short time before death occurred, and in only one was the mastoid process opened. In this instance the mastoid process was found sclerosed, and no pus was evacuated.

In the remaining cases the patients gradually recovered their health, and in all no marked impairment of sight remained, although the optic papillæ were somewhat blanched. With regard to the cerebral symptoms present in these cases, it must be said that they were not very pronounced in all. In some only severe and persistent headache, vertigo, restlessness, and nausea or vomiting were present, but in others there were in addition high fever, delirium, drowsiness, stupor, convulsions, or paralysis of some of the external muscles of the eye. Hemiplegia or general paralysis occurred, however, in none of these cases. Caries and necrosis of the outer wall of the mastoid process existed in most of the cases that recovered. In one case the optic neuritis was not developed till a spontaneous perforation of the outer cortex had taken place on both sides. In the cases without disease of the external part of the mastoid, no opening was made in this process. Facial paralysis was absent in all of the cases of recovery.

If we now inquire in what proportion of the cases ending in death with symptoms of meningitis or cerebral abscess, the optic neuritis was absent, we find that in fully one half of the fatal cases no optic neuritis was developed while they were under my observation. If we include the cases of death from supposed phlebitis and thrombosis of the lateral and the petrosal sinuses this proportion is of course still smaller. (I may state here that I do not remember ever to have seen optic neuritis in cases of pure phlebitis and thrombosis.) In a considerable number of the fatal cases without optic neuritis I was able to continue the examination of the eyes till shortly before death, but some did not see during the last four weeks of their life, and I cannot therefore posi-

tively say that no optic neuritis was developed after the patients passed out of my hands. My information of the fatal termination of these cases was obtained from the physicians in attendance or from the patients' friends. Unfortunately I was unable to make the autopsy in most of the cases that died without having had optic neuritis. In those in which an autopsy was permitted, the clinical diagnosis of meningitis of the base and of abscess of the brain was confirmed by the anatomical examination. Caries of the roof of the tympanic cavity, of the roof of the mastoid antrum, or of some portion of the inner surface of the temporal bone was present in all of these cases except one, and in this instance a discoloration of the inner surface of the tegmen tympani was seen after the preparation had been macerated.

From the above statement it will be seen: first, that optic neuritis is by no means a constant symptom of otitic meningitis or cerebral abscess, and secondly, that the intracranial disease connected with the optic neuritis does not always terminate in death. That the optic neuritis was caused in all of these cases by an inflammation of the cerebral meninges or of the brain itself I am, of course, unable to prove. I think it, however, very probable. Purulent meningitis of the base was found in all the cases with optic neuritis in which an autopsy was made, and it seems, therefore, only fair to assume that it existed also in the cases in which the other symptoms of meningitis were less pronounced and which recovered. Whether in the cases of recovery the inflammation of the inner membranes was not associated with caries and perforation of the dura mater, or if caries was present, only the outer surface of the dura mater was inflamed, as Politzer suggests,¹ or whether simple hyperæmia of the meninges may be sufficient to produce all the symptoms, including the optic neuritis, as Alt² seems to think, can only be determined by further observation. But whatever the actual condition of the meninges or of the brain substance that gives rise to the optic neuritis may be at the time when this first shows itself, it is

¹ "Lehrbuch der Ohrenheilkunde," p. 604.

² "Transactions of the American Otological Society," 1884, p. 236.

quite certain, as we have seen, that it only too often terminates in purulent pachymeningitis and leptomeningitis, and abscess of the brain.

As a rule, the development of optic neuritis in connection with otorrhœa should, therefore, I think, be looked upon as evidence that an intracranial complication has set in or is impending. At the same time the fact should not be lost sight of, that optic neuritis is occasionally developed in persons, more particularly children, free from ear disease and apparently in excellent health, and that therefore, a primary optic neuritis may also occur in individuals with purulent inflammation of the middle ear. Coincidences of this kind are, however, extremely rare. To discriminate a primary optic neuritis from a consecutive one by the appearances of the eye is not possible, and it will, therefore, be safe to regard the eye trouble as a primary disease only when all signs of cerebral irritation are absent. To avoid errors of diagnosis it is also necessary that the examination of the eyes should be begun in the earliest stages of the ear disease, as otherwise we cannot be sure that the optic neuritis did not precede the attack of the ear disease. Only recently a case occurred in my practice which illustrates the importance of an early examination. A well-developed and apparently healthy boy, five years old, in whom I had by mere accident, some weeks before, discovered a well-marked optic neuritis of both eyes, without impairment of sight, was suddenly attacked by great pain in his left ear, high fever, vomiting, intense headaches, and mild delirium. Some days later a perforation of the membrana tympani occurred, with a free discharge. Six weeks later the perforation closed and since then the boy has been well, although he still complains occasionally of headaches. Now, if I had not known the condition of this boy's eyes, or if I had delayed the examination of the eyes till his condition became alarming, I should certainly have attributed the optic neuritis to some cerebral trouble caused by the ear disease. In this connection I would also remind the reader that scarlet-fever and measles, the very diseases that cause most of the cases of middle-ear suppuration, do also occasionally cause

optic neuritis. In these cases the optic neuritis is probably the result of a meningitis, although the symptoms are by no means always pronounced. It should also be borne in mind that tubercular meningitis may supervene on aural disease, and that the optic neuritis may be due to this disease.

With regard to the ophthalmoscopic appearances observed in my cases I need only say, that they differed in no wise from those of the ordinary form of optic neuritis of moderate degree. The swelling of the optic papilla, although never very great, was always distinctly visible during the height of the disease. The color of the papilla was either reddish or reddish-gray, and the edge of the papilla was either blurred or completely hidden. The adjacent retina was more or less opaque and it, as well as the peripheric portions of the papilla, was distinctly striated. The retinal veins were always fuller than normal. Hemorrhages and white plaques on the disk or in the retina were seen in only a few cases. The more intense form of optic neuritis known as choked disk, which occurs in connection with tumors of the brain, I have never seen in cases of otorrhœa. In all except one of my cases the optic neuritis was present in both eyes.

From what has preceded it must be obvious that the presence of optic neuritis does not afford us great help in forming a plan of treatment in all cases. We have seen that cases occasionally recover in which no artificial opening was made in the mastoid, and that in others speedy recovery followed such an opening. On the whole, I believe, however, that it would be best to open the mastoid in every case in which we are reasonably certain that the cerebral disease is due to caries, or to the retention of decaying pus in the mastoid antrum or the mastoid cells. It is needless to say, that the optic neuritis requires no special treatment.

OBSERVATIONS ON THE USE OF THE PEROXIDE OF HYDROGEN IN SUPPURATING EARS, ETC.

By WILLIAM A. DAYTON, M.D.,

SURGEON TO THE EYE, EAR, AND THROAT DEP'T, HARLEM DISPENSARY; ASSIS'T TO DR. ROOSA'S CLINIC, MANHATTAN EYE AND EAR HOSPITAL, ETC., NEW YORK.

FOR some reason the use of the peroxide of hydrogen in suppurative otitis media is not well known. Indeed, so scanty is the literature on the subject that the existence of such a combination as HO_2 had been forgotten by the writer, together with other formulæ, since the last examination on chemistry.

As to the History of the Peroxide or Deutoxide of Hydrogen.

This singular fluid was discovered by M. Thénard in 1818. It was found to bleach organic substances, and was used to restore the blackened lights of paintings which had become darkened from the lead they contain. It was also proposed by M. de Sondala as a means of supplying oxygen to diving-bells and other confined places.

As manufactured (and I understand that it is manufactured exclusively abroad), it is a colorless, limpid fluid (containing 12 %, by volume, of the gas in instilled water), having an acid reaction, metallic taste, and is stable at a low temperature, *but resolves into oxygen and water at 59° F.* It mixes with water in *all* proportions, and becomes more permanent when so diluted.

The use of the fluid in ophthalmic practice has doubtless been made familiar through the writings of Landolt *et al.*,

but a pamphlet by Julius Hensel, of Stuttgart, entitled "Neue Makrobiotic, oder die Kunst Seuchen zu verhüten und zu heilen," and published in 1881, presents a most interesting account of the local as well as the constitutional effects of this agent.

To illustrate its action, Hensel says: If a decomposed egg be mixed with a drachm of a ten- or a twelve-per-cent. solution of the hydrogen peroxide, a somewhat active effervescence occurs, a scum rises to the surface, and the odor of sulphuretted hydrogen disappears, leaving an odor which he compares to that of roasted meat. Again, milk, when mixed in equal proportions with this same solution, can be kept for years without changing.

Its action appears to be confined to decomposed albuminous matters, as blood-albumen and egg-albumen in a fresh state are not perceptibly affected by it.

Hensel, from the standpoint of a chemist, agrees with Dr. Richardson and a few other observers that the peroxide, in weak solutions, must be a valuable remedy in phthisis, as well as in the diseases of all mucous membranes.

My first experience with the peroxide in suppurative otitis media dates from November 3, 1884, when I was induced to try it in the case of a girl, æt. thirteen, who was about to abandon all treatment in hopeless despair. History of the case incomplete. Suppuration probably began in infancy, following an attack of measles. In spite of repeated removals of large granulations, which filled both tympanic cavities alike—in spite of astringents, boric acid, and thorough cleansing,—the discharge of fetid pus continued and the granulations re-appeared.

I do not think that the ossicles were swept away, but there was so much thickening at their site that it was, and is now, impossible to tell.

On November 3d, after the instillation of a four-per-cent. solution of cocaine muriate, with a Buck's curette I scraped out of the right tympanic cavity all the granulations as before. Without syringing the canal, and merely wiping out with cotton a part of the blood that filled it, I poured in about ten drops of a twelve-per-cent. solution of hydrogen peroxide. Immediately an effervescence occurred; the red color of the blood disappeared, a

scum foamed over the concha, and the usual sickening odor was wanting. After drying there was still some cheesy-looking material (pus?) in the canal, which a second application of the peroxide removed. On drying again, I found that the hemorrhage had ceased; the parts were cleaner than they had ever been; the patient considered the operation and the applications alike absolutely painless, and insisted that she "heard things clearer."

Both this patient and myself were so much gratified, that I repeated the same procedures in the left ear, with similar effect.

For two weeks a twelve-per-cent. solution of the peroxide (ten or twelve drops) was instilled into each ear, morning and night. Syringing was omitted. Two weeks later there were indications that the granulations were re-forming; these were touched (once) with a four-per-cent. solution of nitrate of silver, and a five-per-cent. solution of hydrogen peroxide was employed twice daily until the sixth week, when the discharge ceased.

The hearing distance for the watch at the commencement of the treatment was: H. D. R = $\frac{1}{8}$; H. D. L = $\frac{1}{40}$; C tuning-fork heard better through the bone. Since January 2d, by inflation, hearing distance for the watch gradually brought to: H. D. R = $\frac{6}{40}$; H. D. L = $\frac{10}{40}$. Bone-conduction of tuning-fork C, of course, better.

In three cases of acute suppuration of the middle ear, treated at my clinic at the Harlem Dispensary with a ten-per-cent. solution of the peroxide and gentle inflation, the drumheads healed at the end of a week.

About the middle of December last I introduced the use of the peroxide at Dr. Roosa's clinic in the Manhattan Eye and Ear Hospital. The three cases in which it was first tried had all been under observation for purulent otitis media for eighteen months and upward. Within a week marked improvement occurred.

One of these patients complained of "a pounding noise in the ear which kept him awake night after night," and which the bromides failed of relieving. After the third application of the peroxide of hydrogen the discharge from the ear became limpid and inconsiderable, and the "pounding noise" stopped. Out of thirty-four cases of suppurative inflammation of the middle ear treated by peroxide of hydrogen during the past eleven weeks, the discharge has

stopped in nine, and the hearing distance has been improved in all that remained under observation.

In several instances I found that, while the character of the discharge was altered, it did not cease; so that, in addition to the use of the hydrogen, I packed the external auditory canal, after careful drying, with boric acid every other day.

Why it is that some ulcerating surfaces heal without being protected from the air, I do not pretend to say; but certain it is that there are cases in which such protection is required, and I know of no better plan than that of packing the external auditory canal with finely powdered boric acid.

As Dr. Roosa teaches, "it is often necessary for the physician to see cases of suppuration daily for the proper cleansing of the ears"; and I add with emphasis that the most gratifying results from the use of the peroxide have followed when I could superintend, personally, the necessary applications.

More than two applications daily will rarely be required; but surely no fixed rules can well be expressed or adopted in view of the vast disparity which exists in ever-varying pathological conditions. Again, I do not think it always best to use a twelve-per-cent. solution of hydrogen peroxide in suppurative otitis; in children and neurotic subjects the lively effervescence caused by the strong *acid* solution (HO_2) with the alkaline discharge, occasions complaint; and I have seen a strong man swoon during the first application. Indeed, I am inclined to believe that the better plan, in certain cases, is to begin with a six-per-cent. solution, and gradually increase it to twelve per cent. Leading otologists differ as to the relative merits of "the wet" and "the dry" treatment of suppurating ears. It is well known, however, that the use of the syringe, frequently, lights up old suppurations; and, occasionally, patients observe that the discharge decreases when their ears are not syringed. Now, it is in just such cases that the value of the peroxide of hydrogen is demonstrated. I do not know of a single instance, in which its use augmented the discharge. Moreover, I believe it will hasten the process of repair, which syringing often prevents.

The internal administration of a two-per-cent. solution of the peroxide I have tried in table-spoonful doses, with growing confidence in its efficacy.

Dr. B. W. Richardson of London, as well as Mr. Hensel of Germany, has written confidently of its internal use in catarrhal affections of the stomach, intestines, *air passages*, etc., and I am now using a two-per-cent. solution in table-spoonful doses in several abandoned cases of middle-ear catarrh. The slight improvement in the hearing distance of these patients may be a mere coincidence, but I intend to continue the internal administration of the peroxide, in the belief that it may prove a valuable remedy.

By far the larger number of our ear patients are sufferers from naso-pharyngeal catarrh; nor should this be overlooked in the treatment. In fact, I have been as particular in my attention to the nose and throat as to the ear itself.

A spray of a four-per-cent. solution of the peroxide has had an almost magical effect in a case of ozæna complicated with "proliferous" catarrh of the middle ears. It will be observed that the stronger solutions induce local anæsthesia often in a marked degree. This is certainly advantageous, not only in the event of operative interference, but also in doing rhinoscopic work; besides, I have noticed that cocaine acted more promptly after the mucous membrane had been cleansed with the peroxide.

The above is but a hint at the various applications of this agent, should it meet the expectations of interested workers.

Even though no curative results are obtained in the experience of others from the peroxide *per se*, it *will* be found to be a most marvellous cleanser; and, if cleanliness is *the* desideratum in middle-ear suppuration, then we have a servant *par excellence* in the peroxide of hydrogen.

January 23, 1885.

CLINICAL CONTRIBUTIONS TO OTOTOLOGY (THREE CASES).

By W. CHEATHAM, M.D., LOUISVILLE, KY.

A case of atresia of auditory canal.

Mary B., German, age twenty. Had in her early life otitis media suppurativa. Has had no discharge from middle ears for ten years. She came to me stating "her ears were closing up." I found her auditory canal so small as to scarcely admit a Bowman probe No. 1. I could discover no evidence of increase in either the bone or the cartilage of canal. She had no pain, nor any other evidence of inflammation. Appeared to me to be pure hypertrophy of skin of ext. aud. canal. I tried dilators, tents, and incision with no result. The process continued until the canals were entirely closed. They have now been in this condition for one year, with no discomfort, except increase of deafness, with occasional vertigo.

A case of exceedingly small auditory canals.

Annie T., age eleven. Came to me complaining of deafness, that had existed for ten days; hearing good up to that time. Deafness occurred suddenly. No earache. No catarrh. Mother always found difficulty in getting wash rag into ear. Canal always as small as now; find difficulty in introducing Bowman No. 2. Found this small canal plugged with wax. Hearing distance, each, $\frac{6}{48}$. Removed plug of wax, and hearing distance increased to $\frac{48}{48}$. After four months her hearing is the same.

A case of a secondary drum membrane.

Mary R., age fifty, domestic. Reported, complaining of stoppage of ears. Found both auditory canals closed by membranes at external orifice. Membranes appeared to be true skin, not cicatricial tissue. Quite elastic. Apparently plenty of space behind. Gives

history of chronic suppuration years ago. Back of right ear has appearances of previous severe mastoid disease. Says a large bone came from that region some time ago. Bone-conduction is good in left ear, absent in right.

A peculiar part of the case is that she can hear common conversation six feet with her left ear. She can, of course, hear nothing in right ear. She was quite anxious to have me remove the membrane. Believing the normal drum to have been swept away in her attack of otit. med. suppur., and that this membrane was taking its place, I explained its effect to her. She kindly consented to allow it to remain.

A CASE OF ACUTE INFLAMMATION OF THE MIDDLE
AND INTERNAL EARS (PANOTITIS), FOLLOWED
BY FACIAL PARALYSIS AND NECROSIS AND RE-
MOVAL OF THE WHOLE PETROUS PORTION OF
THE TEMPORAL BONE, WITH THE ANNULUS
TYMPANICUS—RECOVERY.

By D. B. ST. JOHN ROOSA, M.D., AND J. B. EMERSON, M.D.

(With four wood-cuts.)

H. G., four years of age, female, was sent to Dr. Roosa February 1, 1884, by Dr. S. G. Carpenter, of Chester, N. Y., who furnished the following history :

"On June 25, 1883, the patient was attacked with scarlet-fever ; eruption was copious ; temperature, 105° ; eruption began to decline on the sixth day. The throat was affected early ; the tonsils, uvula, and pharynx were covered with a dense diphtheritic membrane on the second day ; the nares were also affected, and discharged an irritating mucus. Soon after the ears began discharging. Her general condition was one of coma, from which she could be partially aroused by the handling necessary to cleanse the throat and nares. At the time that the eruption began declining, sloughing occurred in both tonsils. On the tenth day facial paralysis was first noticed on the left side. A little later a puffy swelling made its appearance over the mastoid, which eventually suppurated. There was complete deafness for a time, but later the hearing of the right ear became partially restored."

Her condition when first seen at the office was as follows : There was complete left facial paralysis ; discharge from both ears, that from the left being very fetid and profuse ; there was a fistula in the mastoid leading down to rough bone ; granulations in both tympanic cavities. The general condition was good.

February 2d.—Dr. Roosa made an incision, under ether, through the skin and periosteum of the left mastoid, enlarged the existing sinus in the mastoid cells with a drill, and removed the granulations from the tympanum with a sharp curette. The mastoid cells and ear were washed out with a weak solution of chlorinated soda, and a tent inserted in the wound.

February 3d.—The edges of the wound looking red and infiltrated, a poultice was ordered.

February 7th.—Poultice discontinued; wound looks healthy; a free, fetid discharge from both canal and mastoid opening.

March 12th.—The wound has been cleansed daily with a weak solution of chlorinated soda, and the granulations removed as they sprung up. The discharge has entirely ceased from the right ear, but continues profuse from the left ear.

March 13th.—The opening in the mastoid was enlarged, under ether, and small particles of dead bone scraped off by Dr. Roosa.

March 14th.—There is now an opening down into the mastoid cells about the size of the end of a little finger. In dressing the wound a small fragment of bone about the size of a three-cent piece came away. The patient soon after this was placed in the Manhattan Eye and Ear Hospital, and from this time the notes were made by Drs. Beard and Hale, House Surgeons.

March 29th.—Considerable swelling about mastoid; the auricle was pushed forward. A great deal of fetid pus was discharged both from the canal and the opening. This condition lasted until April 30th, when loose bone was discovered, and a piece of the size of an infant's little finger, was removed by Dr. Roosa.

On May 29th the patient was again placed under ether, and the granulations removed and the carious mastoid cells gently scraped by Dr. Roosa.

From this time until September 23d the wound was dressed twice daily, being cleansed with Labarraque's solution by means of the syringe, and a tent of linen was pushed well to the bottom of the wound. The discharge was very fetid and profuse; granulations were frequently removed, but no tendency to heal was shown, although the patient was in good health; she had no head symptoms or pain. The wound was dressed with great difficulty on account of the sensitiveness of the ear to all handling.

The ophthalmoscope showed no lesion or change in the fundus of either eye.

On September 23d it was discovered that a piece of bone not only

filled the entire opening, but caused tumefaction below. On the next day the patient complained of pain in the ear.

September 25th.—The patient was placed under ether, the wound enlarged vertically, and the bone grasped with dressing-forceps and with slight difficulty removed by Dr. Emerson. There was little hemorrhage.

It was found that the portion of bone removed was the whole of the petrous portion of the temporal bone, photographs of which, taken of the actual size, are herewith exhibited.

For a few days after the operation the discharge and odor were greater than ever, fine particles of broken-down bone continually coming away. On the day following, the malleus bone was washed out in perfect condition.

On Oct. 14th another sequestrum, which proved to be the *annulus tympanicus*, was removed, without ether, by Dr. Roosa. Since then there has been great and constant improvement. All discharge and odor disappeared within a week.

January 20, 1885.—A fistula of one and a quarter inch in depth remains. The discharge from it is usually not sufficient to soil the dressings. The edges are contracting. It is probable that a permanent but small fistula will remain. See fig. 4.

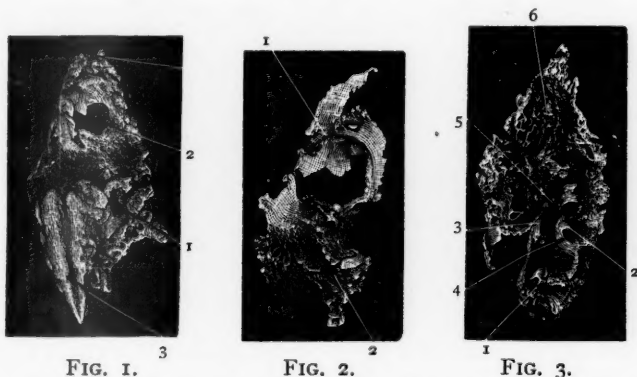


FIG. 1.

FIG. 2.

FIG. 3.

The first specimen (fig. 1) is the entire petrous portion of the left temporal bone. It measures $1\frac{3}{8}$ inches in length, $\frac{3}{4}$ inch in breadth, and $\frac{5}{8}$ inch in thickness. The posterior surface is considerably eroded, and shows near its centre the first turn of the cochlea (1). Posterior to this is the internal auditory canal (2), $\frac{1}{4}$ of an inch in depth. At the lower edge is the groove for the superior petrous sinus (3).

The anterior surface shows the eminence for the superior

semicircular canal in perfect condition; anterior to that the bone is eroded, and the tract of the facial nerve where it leaves the internal auditory canal and enters the tympanum is shown. The outer or tympanic surface (fig. 3) shows the following objects: Beginning at the apex, the bony groove for the Eustachian tube (1); in front of that, the promontory (2); above this, the ovale (3); and below, the foramen rotundum (4); above and external to this is seen aquæductus Fallopii (5); and posterior, the mastoid cells (6).

The second specimen (fig. 2) is the annulus tympanicus and part of the bony external auditory canal. The cut is a view of the internal surface, actual size, and shows the groove for the membrana tympani (1) and the mastoid cells



FIG. 4.

(2). It measures $1\frac{1}{4}$ inches in length, $\frac{5}{8}$ inch in breadth, and $\frac{1}{4}$ of an inch in its thickest portion.

The literature of the subject shows that exfoliation of the cochlea is not of rare occurrence. The cases are too numerous for individual reference in this paper, and they are readily found. Exfoliation of the cochlea and semicircular canals is much less frequent. Cases have been reported by Wilde,¹ Agnew,² Pomeroy,³ Blake,⁴ Toynebee.⁵

¹ Treatise on Diseases of the Ear, p. 158.

² Troeltsch on the Ear, second American edition, p. 471.

³ Transactions of Amer. Otological Society, 1882.

⁴ *Ibid.*, 1880.

⁵ *Archiv f. Ohrenheilkunde*, Bd. 1, 1864.

In Toynbee's cases *the sequestra were not removed until after death*. This fact deprives them of much of their importance. Mr. Shaw, of London, has published a case of exfoliation of the whole of the internal ear and part of the petrous bone.¹ As the case so nearly resembles the one here reported, the main facts are quoted :

"Boy, seven years of age, otorrhœa from scarlet-fever two and a half years ago. Facial paralysis of left side, and complete deafness. Left external ear projected considerably beyond its proper level ; irregular piece of bone, surrounded with granulations, protruded from the meatus into the concha." Mr. S. "first extracted the piece of bone which projected into the concha ; this appeared to have been the posterior border of the external meatus of temporal bone. The cartilaginous tube having been ulcerated by the pressure of the bone fragment, the point of the little finger could be passed to some depth, and another piece of bone was felt rolling freely in the cavity ; this was removed with dressing-forceps with some difficulty. Patient made good recovery, paralysis remaining. The bone removed was nearly the whole of the petrous portion of the temporal bone ; it measured one inch in length and one half inch in thickness, and weighed twenty-two grains. On one side, nearly in its centre, was an opening and cavity, the internal auditory meatus. Depth of canal was three fifths of an inch, showing that the whole of the internal meatus was included. On the side of the specimen in relation to the brain the surface presented the cancellated appearance peculiar to diploë, when it was concluded that the process of separation had taken place in the diploë, and that the cortical layer had retained its vitality, and that, remaining in contact with the dura mater, served as a barrier to prevent the disease from extending to the cerebrum. The opposite aspect of the bone shows the inner wall of the tympanum, etc."

Dr. Pollak, of St. Louis has also reported a similar case of loss of the petrous portion of the temporal bone in these ARCHIVES, vol. x., p. 361.

There was no diploë in the case here reported, and the bone showed markings, such as the uneroded groove for the superior petrosal sinus and the eminence, which conclusively

¹ Transactions of the Path. Soc., Seventh vol., London, 1855.

proves that it was separated from the dura mater throughout the most, if not all, of its extent.

How this could happen without the meninges becoming inflamed, the sinuses obstructed, and the internal carotid artery affected, is not easily seen.

There were absolutely no head symptoms, except the coma occurring during the acute stages of the scarlet-fever. *From this fact, and the fact that the paralysis came on soon (within ten days) after the beginning of the scarlet-fever, we think we are justifiable in thinking that the internal ear and petrous bone were primarily affected with a purulent inflammation, and that it was not, as is generally the case, the result of secondary inflammation extending from the middle ear.*

From the first we maintained a *perfect* and *free* drainage of the products of inflammation, both from the ear and mastoid opening. To this the child is most probably indebted for her life.

The operative interferences were only made when nature, unassisted, proved insufficient for her task of giving a free exit to purulent and dead material. The child took no drug during the eleven months that she was under our care.

ABSOLUTE LOSS OF HEARING-POWER IN BOTH EARS ACCOMPANYING AN ATTACK OF MUMPS.

BY SWAN M. BURNETT, WASHINGTON.

SO long as the direct connection between mumps and loss of hearing-power remains the mystery it is, the thing most needed is an accumulation of as many and as reliable clinical facts as possible. To this end the following case is offered :

John R. Courtney, aged six, was taken with mumps during Christmas week, 1884. Three or four other children in the family had already been attacked, some of them severely, but John's attack was very light. There was very little swelling externally, and internally scarcely any redness or tumefaction was noted. There was no special complaint of pain, and he ran about the house and played in excellent spirits. On the evening of Jan. 1, '85, he was at the table with the other members of the family, and nothing was noticed that called attention to his hearing-power. On the morning of the 2d of Jan. when he got up his brother asked him to bring him his rubber shoes, and he made such an irrelevant answer as led to further investigation of the matter. It was then discovered that he was totally deaf. He could not understand a word though it were shouted into his ears. During the first days after this he would say that he heard beautiful music, and would frequently stagger, and laughingly informed his mother that he was drunk. Aside from this, nothing unusual was noticed or complained of. He was brought to me for examination on the 16th of Jan., and I found the loss of hearing-power complete. The *Mtts* were perfectly normal, and there was only a slight redness of the fauces. At that time there was no unsteadiness of gait.

I saw the case once only, but he was seen several times afterward at the Children's Hospital by my assistant, Dr. Kolipinski, who informs me that, up to date, there is no improvement. He has resorted to large doses of quinine, and blistering behind the ear, without effect.

The points to be specially noted in this case are : 1. That the attack of parotitis was very mild; and the question arises as to whether the force of the morbid influence was not largely spent on the auditory apparatus, and also raises another question as to whether the ear affection was a concomitant affair or a true metastasis. As far as can be ascertained, the deafness came on three or four days after the mumps was first noticed. 2. There can be no question in this case that the deafness is nervous, and any implication on the part of the middle ear can be excluded. The subjective noises and the staggering gait would point to compression in the labyrinth as a cause, and its comparatively sudden onset would indicate an exudation, sanguineous or serous.

ON THE RELATION BETWEEN THE DISEASES OF THE TEETH AND EARS.

By HENRY DICKSON BRUNS, M.D.

NEW ORLEANS, LA.

NOT a little has been written of late upon the harmful influence of dental irritation and disease on the condition of the ears. Ever since the publication of his prize essay "On Affections of the Ear Arising from Diseases of the Teeth,"¹ Dr. Saml. Sexton, of New York, has been first and foremost in this field, and he it was who, in the winter of 1881, called my attention to the subject. I was struck at the time by the fact that I knew well several persons whose teeth were conspicuously bad, but whose keen and delicate sense of hearing I had frequently noted, and even commented upon. It also occurred to me that if dental affections are common among the class which frequents our large hospitals (and this is well known to be the case), we would, of course, often find them associated with diseases of the ear and defects of hearing in the patients applying at our ear clinics.

Acting on these ideas, I have carefully examined the ears of fifty patients taken at random from the medical wards of the Charity Hospital. These patients had never been seen by me before, and the physicians from whose wards they were taken were, for the most part, entirely ignorant of the condition of their teeth and ears.

The tables,² containing the results of my examinations,

¹ *Am. Jour. of Med. Sciences*, Jan., 1880.

² The tables have been omitted for want of space.—EDITORS.

speak for themselves, but the following summary and remarks may not be out of place.

The first point to be determined is the percentage in the class we are dealing with of those having defective teeth. In the table those are set down as having :

Bad teeth in whom	half the back ¹ teeth are carious or missing.
Fair " " "	less than $\frac{1}{2}$, but more than 1 or 2.
Good " " "	1 or 2 back teeth are carious or missing.
Perfect " " "	no " " " "

Taking this standard, the tables show that :

Out of 50 cases	19, or 38 %, have bad teeth.
" 50 "	15 " 30 %, " fair "
" 50 "	9 " 18 %, " good "
" 50 "	7 " 14 %, " perfect teeth.

Ears are said to be perfect when nothing abnormal could be noted at one fairly critical examination, and the Eustachian tubes were pervious (Valsalva's method).

The condition of the ears is, unfortunately, unknown in five cases. Out of forty-five patients, twenty-three have abnormal ears. In seven of the latter the abnormality consists in an excess of wax in *one* meatus; in four, of an excess of wax in *both* meatus; and in thirteen, of some changes in the membrane or other parts of the ear. The ears, therefore, are *absolutely perfect* in twenty-one out of forty-five cases, or in $46\frac{2}{3}$ %, while by glancing above we see that the *good* and *perfect* teeth *together* only amount to 32 %, the perfect teeth alone to 14 %.

Hearing is termed :

Perfect, when a loud whisper is heard well at 15 feet.

Good, when a few of the words in a loud whisper are heard at 15 feet.

Fair, " " " " low tone " "

Bad, " " " " loud " " "

Normal, when no deafness was detected during ordinary conversation before the examination.²

¹ The incisors are seldom found in such a condition as to lay them open to the charge of exciting ear trouble; nor, so far as I know, has such a charge ever been preferred against them.

² Patients were frequently found who were unaware of any defect in their hearing, and in whom a certain degree of deafness was only detectable by a critical examination. In these cases the result of the examination is recorded in the table, the word normal being placed below enclosed in brackets.

In classifying these cases the hearing for the watch was always taken into consideration, although it was never accepted as the standard. It may be noted, however, that in every case in which hearing for the watch was normal, hearing for the voice was absolutely perfect¹; while on the other hand, in many cases in which no imperfection of hearing for the voice could be detected, there was marked dulness of hearing for the watch.²

Out of 50 cases the hearing is bad in 3, or in 6 %	
" " " " " fair " 16, " 32 %	
" " " " " good " 12, " 24 %	
" " " " " perfect " 19, " 38 %	

Certainly these figures, 46 $\frac{2}{3}$ % of apparently perfect ears, 38 % of perfect hearing, and 14 % of perfect teeth, seem to indicate that those cases are exceptional in which dental irritation gives rise to aural affections. But furthermore, the tables show that the side on which hearing is most defective is the side on which the teeth are worse in nineteen out of the fifty cases.³

It is also to be observed that none of those whose hearing was "normal" would have applied to an aurist for aid, as their slight impairment of hearing was not noticeable either by themselves, or by those with whom they conversed.

Now, it is not to be denied that in certain cases diseased and painful teeth do give rise to aural affections; but I believe that in such cases severe and long-continued toothache usually plays an important part: hence they are by no means obscure.

On the other hand, an inflamed ear frequently sets up intolerable toothache. I recall one case especially in which the toothache was extreme. An examination of the teeth, however, showed them to be beautifully sound, but had

¹ Case No. 17 comes nearest to being an exception to this rule, but this is explained by the fact that the man understood English very poorly.

² In cases 28, 29, 30, and 36 I was unable to get the hearing for the voice, but as the watch was distinctly heard at the extreme normal distance, I have not the slightest doubt that the hearing for a whisper was normal.

³ This last point is especially suggestive. If affections of the teeth stand but rarely in a causal relation to affections of the ears, we would naturally expect coincidence of sides in about one half of the cases; *i. e.*, utter indifference of relation as to situation.

there been one among their number in that state of chronic and painless caries which we so often see, who can doubt that it would have been triumphantly pointed out as the cause of all the mischief, and promptly pulled?

Another fallacy lies in wait for our reasoning in this matter. Bad teeth and bad ears are both especially common among the scrofulous and feeble members of our laboring classes, and unless we are wary, it is easy to confound coincidence with cause.

Take, for example, the case of the young man of twenty-two, cited by Dr. Sexton in his paper on "Causes of Deafness among School-children" (Circulars of Information of the Bureau of Education, No. 5, 1881). A dentist would have pointed this man out across a room as the probable victim of bad teeth, while an aurist would have been equally sure that an examination would discover disease of the ears.

Finally, I think it may fairly be said: We know that, owing to the intimate nervous connection of the organs concerned, dental irritation may, *at times*, cause aural disease, and *vice versa*; but in the present state of our knowledge we are to regard such causal relationship as the exception rather than the rule.

CLINICAL NOTES.

By F. M. WILSON, M.D.,

OPHTHALMIC AND AURAL SURGEON TO THE BRIDGEPORT HOSPITAL.

CASE I.—*Inflammation of the mastoid without pain.*

Carrie P. B., age four. Feb. 16, 1883.—Two years ago she had a mild attack of scarlatina, followed by swelling of her feet and by running ears. The right ear stopped running after several weeks. The left has run ever since, up to three weeks ago, when it stopped, and her head began to swell over the mastoid process. This swelling has steadily increased until now, when it involves the tissues from the mastoid nearly to the outer canthus of left eye.

"The swelling has been poulticed for one week steadily, night and day." (?) Little or no redness; distinct fluctuation; loss of appetite, but no coat on tongue. The child is up and about the house, playing with its toys. Pain is not a prominent symptom, and she permits moderate pressure over the whole swelling without flinching. The child has once or twice, within the last two or three days, been for a few moments "out of its head." Temperature, $102\frac{1}{2}^{\circ}$ F.; Wilde's incision; tablespoonful of pus. A probe enters the mastoid readily, also passes upward and forward, so that it can be felt in front of and above the auricle. Cloth tent and vaseline.

February 17th, 8 A.M.—Temperature 99° ; nothing approaching delirium since incision.

February 21st.—Changed tent and syringed cavity twice a day on 17th and 18th, and once a day on 19th and 20th. This afternoon, being urgently called, I saw her and was told that "she had a convulsion about ten o'clock"; "it lasted about five minutes"; "it was not a chill"; "she has been sleepy and stupid since." I made the tent smaller and shorter yesterday, and to-day found

it wholly out of the wound. Temperature, 104° F. ; pulse, 140. I could find no distinct pocket of pus. Slight swelling and tenderness over the parotid gland. The cavity was thoroughly cleansed with the syringe, and large tent renewed. 9 P.M., the patient is sleeping quietly ; pulse, 120.

February 22d, 8 A.M.—Pulse 120 ; temperature, 101° . 9 P.M., pulse, 130 ; temperature, 103° .

February 23d, 8 A.M.—Pulse, 120 ; temperature, 101° .

March 21st.—Temperature and pulse came down to normal, within two to three days after last record. Changed tent twice a day up to March 1st. Have touched no bare bone with probe for at least three weeks. Have never, with syringe or probe, been able to positively demonstrate communication with tympanic cavity or external meatus. Abscess cavity is about one third filled, chiefly from above. Pus began to come from tympanic cavity again during the last week in February.

April 2d.—Cavity two thirds filled and discharging very little. Ear discharging freely.

April 6th.—Discontinued tent.

April 9th.—External opening closed. Free discharge from tympanum.

I have never before seen pus, which undoubtedly came from the mastoid, burrow upward and forward to a point in front of and above the auricle. The comparative absence of pain, redness, and constitutional symptoms is certainly unusual. The most serious symptoms which she had at all followed immediately upon the ill-judged lessening of the size of the tent.

I should say that the outer bony wall of her mastoid must have been very thin, or perhaps wanting altogether. Just why water would not pass from the open mastoid into tympanum, or *vice versa*, I am unable to explain.

CASE 2.—*Acute inflammation of the middle ear ; death in fifteen days.*

A. C. C., aged about forty. Aug. 26, 1884.—While bathing at Coney Island five days ago "got some water in his left ear" ; the next day commenced to have earache, which has persisted since ; and yesterday "the bone behind his ear began to pain him." Left *Mt* red ; slight pain on firm pressure over mastoid ; no

redness ; countenance anxious ; hands tremulous ; temperature, 99° ; pulse, 80. Is so much frightened by any suggestion of danger that I make light of his trouble, but keep him in bed. Hot water and large cotton pad.

August 27th.—Not much change. Still complains of "pain in the bone behind his ear." Three leeches on mastoid.

August 28th.—The leeches gave him immediate and complete relief from pain. I find him up and dressed, and only by much persuasion induce him to remain in-doors. Am to see him again on the 30th, or before, if he sends word.

On morning of 30th he informed me by telephone that he thought he was well enough to go to business the next morning. Eleven days later he died (comatose), and Dr. F. J. Young, who was called just before his death, gives me the following facts. He was up and around for about eight days ; then had a return of pain, but the most prominent symptom was mild delirium. He was sick enough so that his friends kept him in bed, but did not think there was much the matter with him. He would be rational enough part of the time, but would do many strange things—would order them out of the room, and at times would refuse to do any thing they suggested. He took some morphine, and vomited after it. There was no paralysis. Slight redness over mastoid, but no swelling. These symptoms—pain in ear and mastoid (but not severe), delirium at intervals, and vomiting—were the only prominent ones up to the morning of the day he died, when coma came on and continued until his death in the afternoon. An autopsy was not obtainable.

This case is reported from a conviction that every case of the kind, no matter how incomplete the details, should be put upon record.

The aural history of a syphilitic family.

A. B. C. is now about forty years old. Seventeen years ago he contracted syphilis. The sore on the penis was followed by a bubo in each groin, and, later, by a copper-colored skin eruption, scabs in his hair, and loss of flesh and strength. About 1870 he came under the care of Dr. R. Hubbard, of Bridgeport, Conn., and was under treatment nearly all the time until 1880. His principal symptoms were sore throat and disease of the right femur. The throat trouble was intermittent, and always yielded

readily to treatment. The disease of his femur was near the lower end, and as he would not keep still, but insisted on walking about, it kept him lame from about 1873 to 1880.

Since that time he has had no symptoms. He admits that he infected his wife, but cannot tell whether she had a primary sore or not. He does remember that she had a copper-colored scaly eruption all over her body.

At the time of her first pregnancy, about fourteen years ago, both were free from symptoms, except that he had sore throat. She, however, miscarried at six weeks. Also in the next pregnancy she miscarried at two months.

Their first living child, a girl, is now thirteen years old. A discharge of pus from both her ears began when she was three months old; they discharged steadily for three years. In that time, though quite deaf, she learned to talk, but her hearing got worse and worse, and she forgot many of the words she had learned. I saw her March 8, 1880, and made the following record in my case-book: "Hears loud gong-bell on right side, three feet; not at all on left. Blake's tuning-fork, when placed on vertex or teeth is heard on right side, but is not heard through the air; drum membranes gone, and probably, also, the ossicles." This girl is being educated as a deaf-mute. She has taken Hg and KI. in large quantities since becoming deaf, but she did not take them when her symptoms first appeared.

The second living child, a boy, is eleven years old. I first saw him Jan. 26, 1885. His ears both discharged when he was a baby, but this discharge ceased in a few weeks after taking mercury and iodide of potassium. He has had no trouble since, until a few weeks ago, when his father noticed that he did not seem to hear well, and that he kept getting worse every day. He has complained very little of pain, but if questioned, he would always admit that his ears "ached a little."

The R *Mt* was red over its entire surface, but light spot not entirely obliterated; circular scar 3 mm. in diameter behind and below handle of malleus.

The L *Mt* was uniformly purplish red, less concave than normal, no light spot; linear scar about 3 mm. in length directly behind handle of malleus.

There was no pharyngeal or nasal catarrh; bone-conduction best in both ears.

$$R\ E, W = \frac{5}{40} \text{ after infl. } \frac{10}{40}$$

$$L\ E, W = \frac{3}{40} \text{ after infl. } \frac{7}{40}$$

Somewhat anæmic. Has been taking KI for several weeks. I prescribed inflation and syr. ferri iodidi. He has one oval brownish scaly patch on his right temple, and a small indolent ulcer on inner surface of lower lip. After two weeks' treatment, R E, W = $\frac{8}{40}$ L E, W = $\frac{5}{40}$; appearance of drum membranes about the same.

In the fifth pregnancy miscarriage occurred at 3-3½ months, which was attributed to riding over rough roads.

The next child, a girl, died, when a few months old, of *brain trouble*.

The third living child is a boy, age six, healthy. In eighth pregnancy miscarriage occurred at two months, attributed to lifting.

The fourth living child is a girl, age three, healthy. The fifth and last living child, now fourteen months old, had, when a few months old, "*running ears*," which stopped running in a few weeks *after taking* mercury and iodide of potassium.

On January 27, 1885, I was called to see the child, and found subacute otitis in both middle ears, also cicatricial drum membranes, also on various parts of its body brownish spots from $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. Feb. 17, 1885, Dr. Hubbard tells me that the baby has measles, and that its ears are running again.

The history of this family shows that we have a father undoubtedly syphilitic, and the mother probably so. We have four miscarriages. We have one child who lived only a few months, and died of *brain trouble*. We have five living children. Of these, three had suppurative otitis media *within a few months after birth*. In the oldest child the disease was progressive, and finally involved the internal ear, making her a deaf-mute. No one remembers that she took any mercury or potash until her ears had run at least two years.

We have in the next child a suppuration of middle ears which got well after taking the drugs just mentioned, and subsequently subacute inflammation of middle ears. We then have two healthy children, and lastly a baby fourteen months old, and he also has had suppurative inflammation of both middle ears, which disappeared after taking Hg and KI, and has since had subacute otitis media, which afterwards became suppurative during an attack of measles. It should be noticed that he was born two to three years after father's symptoms had ceased.

The history I think can be relied upon. The father is an

intelligent man, and has never shown any disposition to evade inquiries, but rather sought to facilitate them. Dr. Hubbard has had this family under constant supervision since 1870, and is too acute an observer to have been misled upon any important part of the history. The statements taken from my case-books were recorded at the time the observations were made, and I think are in the main correct.

There are, it seems to me, three ways of explaining the otitis: First, we may deny the influence of the syphilis altogether; secondly, we may admit its influence indirectly by lowering the vitality of the children; and thirdly, we may infer a specific deposit of syphilitic poison in the mucous membrane of the tympanum itself, affecting it as it does the mucous membrane of the throat. I am free to confess that the facts do not justify any dogmatic choice between the three.

Theoretically I can see no reason why syphilis should not manifest itself locally in the mucous membrane of the tympanum, as well as in the mucous membrane of the throat; practically I am led to disbelieve it from the fact that I have seen many throats affected and no tympana (in which I felt sure of the specific origin), and also from the fact that there is little or no literature upon this point.

It is very easy where there is a syphilitic taint in a family to attribute every thing to it, but I think that no thoughtful man could study this family history without having it forcibly suggested to him that the otitis media of these three children might be a local manifestation of hereditary specific poison.

THE COMBINED MANOMETRICAL EXAMINATION AS AN AID IN THE DIAGNOSIS OF EAR DISEASES.

BY A. EITELBERG, OF VIENNA.

Translated by Dr. J. J. B. VERMYNE, of New Bedford, Mass.

THE manometrical examination of the organ of hearing, for physiological and diagnostical purposes, has been cultivated so thoroughly and extensively by many excellent investigators—I mention only Politzer, Lucae, and Hartmann,—that further studies do not promise to yield new results of much importance. In my experiments I have principally aimed at ascertaining the diagnostic value of this method, as compared with other well-known methods; in particular, to point out such cases as can correctly be diagnosticated by the new method alone. For this purpose I have used both the metallic manometer, as used by Urbantschitsch,¹ and the aural manometer, described by Politzer,² singly and also often in combination.

The difficulty of securing an air-tight closure of the external meatus by one end of the aural manometer is a matter which many observers have endeavored by various means to overcome. Fick³ used in his experiments a glass tube, several inches long, open and thick at both extremities and of very narrow calibre (thermometer tube). Around the end to be introduced into the external meatus, he wound a

¹ "Lehrbuch der Ohrenheilk.," 1. Aufl., 1880, p. 30.

² Sitzungsberichte der mathem.-naturwissenschaftlichen Classe der K. K. Academie d. Wissenschaften, 1861, Bd. xliii., pp. 427-438.

³ Müller's Archiv f. Anatomie, etc., 1850, pp. 526-528.

strip of vulcanized rubber, until "a plug was formed, about the size of the meatus at its entrance in the petrous bone." It is a matter of course, that before using this or Politzer's aural manometer the ear should be cleared of any cerumen, which, by closing the tube, would make the experiment useless. Politzer's manometer is furnished at its aural extremity with a piece of cork or rubber, corresponding in form with the entrance to the meatus auditorius externus, and which, previous to introduction, is lubricated with tallow.

In this manner, however, a gradual loosening of the aural manometer within the meatus and a consequent interruption of the experiment can hardly be avoided. Lucae¹ has found in previously heated gutta-percha a practical means for obtaining a permanent hermetic closure. Of this fact one can easily convince himself during the action of the muscles of the lower jaw, whereby the external meatus is alternately narrowed or widened, and consequently changes must occur in the position of the fluid in the aural manometer.

To the horizontal extremity of Politzer's manometer I have attached a rubber piece in the form of a truncated cone, and this being lubricated with vaseline, the instrument is introduced into the meatus, and, notwithstanding the difference in volume of the meatus in the persons experimented upon, I have obtained hermetic closure in many cases. If this, however, did not succeed, I have been more fortunate by winding around the rubber end-piece a layer of cotton-batting lubricated with vaseline, corresponding in size with the capacity of the meatus in question. Thus it has often occurred that the fluid entirely entered into the meatus externus. For the manometrical fluid I now—after many unsuccessful attempts with other colored fluids—use exclusively carmin. On introducing the aural manometer the carmin first mounts to the border of the outer end of the manometer, and if the instrument is left to itself, unsupported, the fluid falls in the ascending part of the instrument, rises gradually in the descending part, and at the

¹ *Archiv f. Ohrenheilk.*, Bd. i., pp. 96-106. •

slightest effort to remove the manometer from the meatus, it entirely enters into the meatus. In some few cases where the aural manometer, hermetically introduced, had been left to itself, the escape of the carmin into the meatus took place so rapidly, that further experiments could not be made. This has occurred especially in cases with extensive or total destruction of the *Mt*, or, if this membrane was intact, in cases where the meatus was very wide and long.

I think the physical explanation of this phenomenon is as follows: By the forcible introduction of the manometer into the external meatus the latter becomes mechanically shortened in its longitudinal axis, on account of the mobility of the cartilaginous part. The column of air contained within the meatus, being compressed into a smaller space, increases in density, and forces the drop of carmin outwards. If the manometer is no longer supported by the hand, its own weight causes outward traction; the external meatus is again drawn out, the air becomes less dense, and the fluid within the manometer is aspirated. This aspiration becomes easier if large perforations exist, because the air of the meatus can then escape into the tympanic cavity and the mastoid cells, and the rarefaction of air takes place more promptly. Notwithstanding the partial change of position of the aural manometer, the hermetic closure remains the same, which is proved on the one hand by the occurrence above mentioned, and on the other hand by the fluctuations of the fluid, produced by action of the muscles of the maxilla inferior. During the experiment, however, this action must be carefully avoided. Nevertheless,—in order to guard against mistakes,—it is necessary that the position of the manometer is accurately controlled, and the result obtained should be considered correct only when repeated experiments at the same session give approximatively the same figures. Manometrical examinations at different intervals, in the majority of cases, manifest marked differences. This fact was already stated by Politzer (*l. c.*), and from his manometrical experiments he drew the following conclusion: The walls of the tubæ adhere more or less closely, not only in different persons, but also in the same person at

different times, so that oftentimes a large, and at other times a slight, difference in pressure suffices to separate the walls.

As has been stated at the beginning of this paper, my object was especially to study the value of manometrical examination as an aid to diagnosis. In twenty individuals in whom the experiments were frequently repeated, I pursued the following *modus operandi*. By means of auscultation during the application of the catheter or of Politzer's method by the introduction of bougies, and, in appropriate cases, by the rhinoscope, I endeavored to obtain a correct idea of the condition of the tubes. Next I examined the *Mt*, as regards its mobility, with Siegle's speculum, and then applied the metallic manometer. In using this instrument I endeavored to ascertain, by auscultation, the smallest amount of pressure needed for ventilation of the tympanic cavity in Politzer's experiment during the act of swallowing, pronunciation of "hck," or sounding the vocals, and also in the application of the catheter. I then combined the use of the metallic manometer with that of Politzer's aural manometer, in order to notice the lowest degree of pressure needed, in the different methods of inflation, to produce a change in the column of fluid in the aural manometer.

With regard to the value of auscultatory murmurs for diagnostic purposes, it is a fact that they offer but few reliable points for diagnosis of ear diseases. Magnus¹ has thus stated "that our judgment from results of auscultation has but slight actual foundation, and the origin of the auscultatory sounds is exceedingly complicated." According to this author, not only is the escape of air at the beak of the instrument in the fossa triangularis of the utmost importance, but there are also sources of error in the force-pump or inflators, whereby the interpretation of auscultatory sounds is made very difficult. A decisive proof of the unreliability of these sounds in judging of the width of the tubes has been given by Urbantschitsch.² In a series of cases he found, by application of the bougie, narrowing of

¹ *Archiv f. Ohrenheilk.*, Bd. vi., pp. 246-262.

² *Wiener med. Presse*, 1883, Nos. 1-3.

the tube, especially at the isthmus, while from the character of the auscultatory sounds apparently no obstacle existed against free entrance of air. On this ground Urbantschitsch in diseases of the middle ear, and especially in chronic catarrh of the middle ear, always practises the introduction of bougies in the Eustachian tube.

From these observations it is shown that the importance of manometrical examinations, especially when simultaneously performed with the aural and metallic manometer, is not to be underrated. We can, however, not ignore the fact that in one case, where the isthmus only admitted a bougie of $\frac{3}{8}$ mm., with an atmospheric pressure (0.06) corresponding with the normal volume of the tubes, air passed into the tympanic cavity during the act of swallowing in Politzer's experiment or during catheterization. Of this I became thoroughly convinced, not only by auscultation, but also by the change in the manometrical fluid.

It ought here to be mentioned that, with regard to the results of the examination, it is not always matter of indifference whether one uses a short catheter, unprovided with a special arrangement for receiving the air-bag, or an olive, by which hermetic closure is more easily obtained. Hartmann¹ closes the nasal cavity by means of a double olive, one connected with the inflating apparatus, the other with a mercurial manometer.

I will now more especially consider the value of manometrical examination for diagnosis of diseases of the tuba, particularly with regard to its calibre, in order to ascertain how far this method enables us to judge of the free, or more or less defective, mobility of the membrana tympani.

In regard to the first I have shown more in detail in another paper,² that by means of this examination we are able to diagnosticate stenosis of the tubæ at their pharyngeal aperture. A. Hartmann³ succeeded in this manner to define the degree of constriction in a boy of fourteen, who exhibited symptoms of tubal stenosis. In this patient at

¹ Experimentelle Studien über die Function der Eustachi'schen Röhre, Leipzig, 1879, p. 30.

² Zeitschr. f. Ohrenheilk., Bd. xiii., pp. 132-145.

³ Virchow's Archiv, Bd. lxx., pp. 447-460.

an expiratory pressure of 130 *mm.* Hg., no air penetrated into the tympanic cavity; during deglutition a pressure of 80 *mm.* was needed for the left, and of 100 *mm.* for the right, side. After introduction of the catheter the air entered on both sides at a pressure of only 10 *mm.* It may here be observed that, according to the experiments of Hartmann (*l. c.*), Urbantschitsch,¹ and myself, a pressure of 10 *mm.*, or a little above, suffices in Politzer's experiment to force the air through a normal tube into the tympanic cavity during the act of swallowing.

(While performing Politzer's experiment with pronunciation of "hck," or sounding the vocals, an atmospheric pressure just a few hundredths greater is necessary for ventilation of the cavum tympani. If, however, in Politzerizing while swallowing, a pressure of over 0.1 atm. is needed, the relative difference of pressure for the same purpose in the same case during the pronunciation of "hck" or sounding the vocals will be 0.1, to 0.15 atm.)

According to Hartmann, we obtain by this method a definite measure of the swelling of the tubæ, whereas a diagnosis of this swelling from the auscultatory sound, as heard during catheterization, according to the above statement, is not very reliable. Among the individuals experimented upon by myself were three cases of tympanitis purulenta chronica—in two cases bilateral—and one case of chronic catarrh of the middle ear, where by Politzer's experiment with swallowing a pressure of 0.2–0.3 atm. (0.1 atm. = 75 *mm.* Hg.) was necessary for ventilating the cavum tympani—that is, for mobilization of the column of fluid in the aural manometer, while in catheterization a pressure of 0.03–0.08 atm. sufficed. This method, however, only gives us light with regard to swelling of a part of the cartilaginous-membranous tube. For if we consider that this cartilaginous-membranous tube in the adult is 24–30 *mm.* long, while the end of the catheter, in the most favorable circumstances, does not penetrate farther than about 10 *mm.*, it follows that by manometrical examination swelling of the Eustachian tube can be diagnosticated with certainty only

¹ "Lehrbuch der Ohrenheilk.," 1880, 1 Aufl., p. 29.

when occurring at the pharyngeal third. If stenosis exists beyond this third, or in the osseous tube, the bougie has to be resorted to in order to ascertain the seat of the stenosis.

Another pathological process in the diagnosis of which manometrical examination affords great service is paresis of the tubal muscles, described by Weber-Liel. The diagnosis of this disease is based upon "the marked incongruity of the tactile and acoustic results of the examination." While the tube, even in the later stages of the disease, retains its permeability for large bougies ($1\frac{1}{4}$ – $1\frac{1}{2}$ mm.), the auscultation sounds become gradually duller, as coming from a distance, and are often only recognizable by resorting to swallowing.¹ In alternating rarefaction and compression of the air in the external meatus by means of Siegle's speculum, the *Mt* is easily movable. That the tube is almost completely impervious to air, notwithstanding the possibility to introduce large bougies through the isthmus, is proved by the fact that if we attempt to force air into the tympanic cavity under great pressure, no change is observable in the fluid of the aural manometer, although on the part of the *Mt* or the tympanic cavity no obstacle exists.

Among my twenty subjects for manometrical experiments were two of these cases already in an advanced stage of the disease. One was a man over sixty, the other a woman of thirty. In both cases the tube easily admitted bougies of $1\frac{1}{2}$ mm., and the membr. tymp. were movable on examination with Siegle's speculum. In the first case I still observed a dull, thin auscultation sound during catheterization, with a pressure of 0.12 atm.; in the second case a similar sound was obtained with 1.08 atm. On the other hand, however, during the same process of catheterization, the fluid in the manometer remained unmovable with a pressure of 0.3 atm. (= 225 mm. Hg.). Hence a comparative small pressure during inflation may produce a sound, however dull and distant, while at the same time it is impossible to force the air into the tympanic cavity by using a much higher pressure. I believe, therefore, that through the combined manometrical experiment we do gain a decided point

¹ Weber-Liel, *Progressive Schwerhörigkeit*, Berlin, 1873, pp. 30-33.

for the diagnosis of relaxation of the tubes, and especially for the extent of the affection.

The manometrical experiment will also enlighten us with regard to an anomaly of the tubes, in the diagnosis of which, even the bougie leaves us rather in the dark, while catheterization and inflation in general only give partial disclosure. I have, as yet, not met with a typical case of this disease during my manometrical experiments, as the anomaly of which I am speaking occurs but rarely. I refer to flexions of the cartilaginous-membranous tube, or, what occurs more frequently, the osseous tube. At the point of flexion the bougie will meet an unsurmountable obstacle; perhaps auscultation may reveal a normal sound, but the positive result of combined manometrical experiments—metallic or mercurial and aural manometer—can only decide for a free passage of air through the tube. Of course it is premised that tympanic cavity and *Mt* are in a healthy condition, a fact which can be positively ascertained. Based upon the results of the combined manometrical examination, the length of that part of the bougie from the end of the catheter to the seat of the obstacle will enable us to judge whether the flexion exists in the cartilaginous-membranous or in the osseous part of the tube.

Finally, this method renders it possible to recognize subacute swelling of the mucosa of the tube, which is not infrequent in the course of chronic middle-ear disease, and with more accuracy than by tactile examination. Of this I became convinced in four typical cases of subacute swelling. In these cases I still succeeded, with a little trouble, in passing the bougies, which usually passed through the isthmus, but in order to carry the current of air into the tympanic cavity, and to produce a change of level in the manometrical fluid, a much greater pressure was needed. An acute or subacute catarrhal swelling, so long as it remains soft, and has not attained the degree of consistent infiltration, is easier overcome by a solid object than by a current of air. A temporary occlusion of the tubes, as by a plug of mucus, can be safely excluded, as repeated inflations previous to manometrical examination and probing the tubes certainly would have removed such an obstacle.

Assuming that the action of the tubes is normal, the degree of mobility of the *Mt* can also be estimated by the method of examination in question.

In the first place, the respiratory movements of the *Mt* can yet be recognized by manometrical observation, when ocular inspection fails. It is known that, according to Lucae (*l. c.*), the fluid in the manometer shows in the majority of people a positive fluctuation at inspiration, a negative one at expiration, while only in a small number of cases the reverse occurs. This diversity of movement of the *Mt* depends, according to the same author, upon the kind of movement of the soft palate during respiration. Accordingly, as in the act of inspiration—or expiration—the soft palate rises, air will penetrate into the tympanic cavity in either one or the other period of respiration; the *Mt* will then be pushed outward, and the manometrical fluid will show a positive fluctuation, while during expiration—or inspiration—a negative fluctuation occurs.

Differing from the fluctuations in the manometrical fluid which are produced by the respiratory movements of the *Mt*, are those coincident with the frequency of the pulse, and which have been observed by Politzer and Lucae. The latter author believes that they indicate "changes of volume depending on pulsation." I am not able to decide whether these fluctuations of the manometrical fluid depend upon movements of the *Mt* itself produced by the pulse. This is a question already raised by Lucae. I have been able to observe them in two cases attended with large defect of the *Mt*.

For the sake of completeness, mention should yet be made of those fluctuations of the manometrical fluid which are produced by involuntary contraction of the muscles at the entrance of the ear during intent listening, and this circumstance Gellé¹ suggests to be employed as a means of detecting simulation, because a conversation in whisper, of interest to them, will cause them to listen. It is obvious that in this, as in all other observations of this character, swallowing and movements of the jaw should be carefully excluded.

¹ *Canstatt's Jahrbücher*, 1877, Bd. i., p. 479.

For his experiments in the production of artificial deafness Cassels¹ also uses Politzer's aural manometer, in order to demonstrate the rapid rarefaction of air in the tympanic cavity, when swallowing is practised a few times with closed nostrils. Already after the third swallowing the mercury—which he uses instead of carmine or sulphuric ether—has entirely escaped into the meatus auditorius externus, into which the manometer has been hermetically introduced. This proves considerable degree of retraction of the *Mt*. When Cassels performed the same experiment under ocular inspection of the membrane, it became in a very short time strongly concave, in conformity with the result of the manometrical observation. Besides this, congestion of the blood-vessels of the manubrium, and subsequently of the other blood-vessels of the *Mt*, is observed, with a general confusion and a lowering of all tones, at times also with tinnitus. It is a matter of course, that Cassels experimented only on persons with healthy organs of hearing.

The air, which during the act of suction (aspiration) becomes condensed in the naso-pharyngeal cavity, also penetrates into the tympanic cavity, although a distinct positive fluctuation of the manometrical fluid is not always evident.²

According to Politzer, (*l. c.*), adhesions of the *Mt* can be easily demonstrated by the aural manometer. But it is obvious that this only refers to extensive, or even rather complete, adhesion of the *Mt* to the opposite tympanic wall, or to adhesion of the membrane with the corresponding mucosa tympanica. Partial adhesions, especially when not caused by too short or too firm bands—the products and remnants of past inflammatory processes within the cavum tympani,—cannot be demonstrated by the aural manometer, because the *Mt* is only partially obstructed in its excursions during ventilation of the tympanic cavity, and therefore still shows its influence upon the column of air in the external meatus, and consequently upon the position of the manometrical fluid. A slight degree of fluctuation in the

¹ *Zeitschr. f. Ohrenheilk.*, Bd. xiii., pp. 126-131.

² V. Lucae: *Virchow's Archiv*, Bd. lxiv., pp. 476-504.

manometer, produced by alternating condensation and rarefaction of air in the tympanic cavity, does not allow us to judge with regard to existing adhesions. For supposing the experiment to be made with entirely normal tubes, the degree of these fluctuations gives a measure for determining the greater or less mobility of the *Mt*, but does not indicate whether or not it is adherent at a certain point. In such a case examination by Siegle's speculum will be of service.

But by means of the manometrical experiment in connection with the result of other methods of examination, we can, at least with a great degree of certainty, judge of the rigidity of a totally thickened drum-membrane. I was enabled to do so in one case, that of a well-preserved man of sixty, suffering for many years from chronic middle-ear catarrh. The naso-pharyngeal cavity was entirely normal. The isthmus tubæ of either side easily permeable by a bougie of $\frac{4}{3}$ mm. During swallowing in Politzer's experiment, also in catheterization, the tubes admit the current of air at a pressure of 0.05 atm. easily, for, on auscultation, a near, broad, and soft percussion sound is heard, *Mt* but little retracted, and manubrium almost in normal position. But the transparency of the *Mt* has entirely disappeared, the membrane is thickened and immovable on application of Siegle's speculum. The patient states that there never was any purulent inflammation of the middle ear. At the combined manometrical examination with a pressure of 0.35 atm. (the highest pressure I could reach in using the metallic manometer), I had a negative result with regard to mobility of the membrana tympani. I felt, therefore, justified to diagnosticate this case as one of high degree of rigidity of the *Mt*.

A consideration of the facts discussed in this paper shows that the combined manometrical examination is of decisive importance in the recognition of certain morbid processes and anomalies of the middle ear, whereas in others it furnishes valuable additional data to make the diagnosis more accurate.

ON LACUNAR CARIES OF THE HANDLE OF THE HAMMER.*

BY PROF. S. MOOS, OF HEIDELBERG.

Translated by J. A. SPALDING, M.D., Portland, Maine.

(With figure 1, plate 1.)

THE extraordinary vascularity of the ossicles of hearing is very favorable to the development of caries. Yet, so far as I know, no one has ever observed or described a case of *primary caries* of these bones. The hammer is the one most frequently attacked, the stirrup most rarely. The immunity of the anvil from the disease, in comparison with the frequency with which it attacks the hammer, does not in my opinion depend upon the slighter vascularity of the anvil, but upon the circumstance that in those severe suppurative inflammations of the tympanum which are likely to be followed by caries of the ossicles, the anvil, being but loosely fastened to the adjoining ossicles and tissues, is almost invariably exfoliated *in toto* at a very early stage of the suppuration, and before caries can attack it. Thus we frequently find that when the suppurative inflammation has in some peculiar way produced an abnormal rigidity and fixation of the hammer so that the anvil cannot be exfoliated as usual, the latter ossicle suffers from caries just as frequently as the hammer.

Allow me now to suggest that caries of the handle of the hammer is really of more value to general pathology than

* A paper read before the Third International Otological Congress at Basel, Sept. 2, 1884.

to otology alone. Those things which happen on a large scale are frequently repeated *in petto*, and there is scarcely any object more easy to handle, or more suitable to investigate, or one in which we can better study all the finer processes of caries as we have become acquainted with them on the extremities of the larger bones, than the carious handle of the hammer.

My investigations into the blood-vessels and circulation of the membrana tympani and handle of the hammer¹ have demonstrated that the latter is but slightly nourished by the arterial blood from the cutis, because it is covered at both of its angles and at its inner surface—in other words, upon the greatest part of its circumference—by the mucous membrane, which is rich in blood-vessels, and *mainly* furnishes the material for the nourishment of the handle of the hammer. The mucous membrane, therefore, must first be diseased before caries can attack the handle of the hammer.²

It is a well-known fact that the mucous membrane of the *Mt.* during a suppurative inflammation of the tympanum, suffers from a hyperplasia which is partly caused by an infiltration of round cells, and still more by an infiltration of pus cells as well as by enlargement of the blood-vessels. At this time the mucous membrane frequently measures $\frac{3}{8}$ mm. or more in thickness, and may remain in this condition until death. In other cases, however, the suppuration produces dissolution and exfoliation of the mucous membrane, the latter process being the first condition necessary for the development of caries of the handle of the hammer. The membrana propria, which envelopes the handle of the hammer, and the periosteum also, are now attacked, undermined, and stripped off by the suppuration, whereupon an extremely vascular granulation-tissue forms now at one spot, now at another, upon the inner surface of the periosteum. As the granulations increase in size and coalesce with one another the tela ossea is gradually dislodged. The proliferation of the granulation-tissue, when once established, can extend in all directions, as well up-

¹ These ARCHIVES, vol. vi., p. 574.

² It is also possible that caries of the handle of the hammer may be caused by suppurative destruction of its lateral periosteum.

ward and downward as in a transverse direction, while if the process continues for any length of time, the periosteum and the membrana propria itself may be partially or even wholly destroyed. During this destructive process, however, some portions of the tela ossea, especially those in the centre of the handle, may remain intact, under which circumstances, when observed in transverse sections under the microscope, they appear in the shape of infinitesimal sequestra still held *in situ* by the granulation-tissue. Finally, these also yield to the destructive process or melt away. We then see nothing except a bit of bone more or less closely in contact with the lateral periosteum, or else that part of the handle concerned is entirely destroyed, and the handle is in this manner shortened by caries and necrosis, or the entire handle as far as the head of the hammer is lost.

Under the name of *lacunar caries*, we understand that form of deliquescence of the bony tissue in which the edge of the undermined portion always exhibits a characteristic line composed solely of small arcs of a circle. It is chiefly produced upon the handle of the hammer by the indirect action of granulation-tissue, rarely by the action of giant-cells. Indeed, these cells are frequently absent in cross-sections of the lacunæ, while in others we meet with them but rarely, and even then they do not invariably lie upon the inner surface of the cavities, but scattered irregularly amidst the granulation-tissue, now oval, now round, and sometimes with from three to eight or even more nuclei. Occasionally also we see them lying together in enormous groups, one giant-cell overlying another along the entire arched boundary line of the lacuna.

It is an interesting fact, so far as the osteoclastic theory is concerned, that in cases of caries of the handle of the hammer, the osseous tissue is for the most part pushed back by granulation-tissue and only partially by multinuclear cells. Thus, for instance, Pommer, who has lately studied this subject very carefully,¹ denies that granulation-tissue has any share in the formation of resorption-lacunæ in the

¹ On the Osteoclastic Theory, *Virchow's Archiv*, Band xcii., 1883.

physiological growth of bone, and decides in favor of the osteoclasts as the real resorption-organs of the bony tissues. In my opinion, however, *both of these processes are possible in pathological cases*, and in such the granulation-tissue has a greater share in the resorption of the bony tissue than the multinuclear or giant-cells. According to previous theories, it used to be generally assumed that the multinuclear cells originated at one time from inclusion and at another from confluence of the granulation-cells, and finally from multiplication of the cellular protoplasm and subsequent division of the nuclei. Pommer, however, explains their origin by local increase in the blood pressure, whereby we have an increased transudation, and alteration of the processes of diffusion, so that the growth of the cells is favored, and those next to the bone obtain osteoclastic properties. Finally, according to the same author, similar occurrences may come to pass in inflammatory processes.

Explanation of the Figure.

This exhibits a cross-section through the torso of the middle of the handle of the hammer. Hartnack, $\frac{2}{3}$. The mucous membrane is everywhere absent from the remnants of bone. The greater part of the tissue lying between the crumbled bone is composed chiefly of very vascular granulation-tissue. On the contrary, the lacunæ in the bone lying almost wholly to the left are filled with multinuclear so-called giant-cells. The lacunæ themselves are sharply defined against the remaining bony tissue by larger or smaller arc-shaped borders. At *s* sequestra held *in situ* by granulation-tissue.

The periosteum and perichondrium, together with the osteoid tissue, situated upon the periphery of the handle, are only preserved at the right half of the specimen, and at *mp* are united with the membrana propria which extends to the membrana tympani (omitted in the figure).

RA, direction of the cross-section toward the external auditory meatus.

RT, direction of the cross-section toward the tympanic cavity.

ON VASCULAR VILLI OF THE TYMPANIC MUCOUS MEMBRANE.*

BY PROF. S. MOOS, HEIDELBERG.

Translated by J. A. SPALDING, M.D., Portland, Maine.

(*With figure 2, plate 1.*)

GERLACH has already described various microscopic elevations of the mucous membrane of the membrana tympani, some globular, like the papillæ of the tongue, and some finger-shaped, like intestinal villi. The former, according to Gerlach, attain so enormous dimensions that they can be seen with the naked eye in transmitted light. They are composed, centrally, of the common sort of connective tissue, but at the periphery, of a more homogeneous connective tissue, and contain one or more vascular loops, but no nerves. They are covered with a single layer of pavement-epithelium. They are more numerous on the membrana tympani of new-born children, and as some of them are connected with the mucous membrane of this membrane with pedicles only, Gerlach thinks that they ought to be called villi of the membrana tympani.

Many preparations of my own confirm this assertion of Gerlach's. Some of them are longitudinal sections made from the circumference of drum membranes, treated with osmic acid, of the new-born and of infants in the first weeks of life. In these specimens we obtain so excellent a topographical view of the villi that we can easily count them.

* A paper read before the Third International Congress at Basel, September 3, 1884.

In the course of histological investigations, which I was carrying on for quite different purposes, I twice had an opportunity of discovering *villi of the inner tympanic wall*.

The first case was that of a child which came into the world in an asphyxiated condition, but was brought back to life only to die ten days later.

The second case was that of a foetus of four months, that had been injected from the abdominal aorta.

As you see from the sketches which I have submitted to you, these villi bear the greatest resemblance to those of the intestines. They appear, however, both in their position as well as in their numbers to confine themselves to a particular locality: topographically, because they are never found in cross-sections (through the *Mt*, handle of the hammer, and neighboring tympanic wall) made below the superior third of the handle of the hammer; numerically, because we rarely meet with more than eight. They rest upon the inner tympanic wall opposite the posterior periphery of the *Mt*, but on this side of the locality where the fibres of the membrane are inserted into the annulus tympanicus. They look somewhat like a finger, and measure about 0.2 *mm.* in length and 0.055 in breadth. They are evidently prolongations or protrusions of the mucous membrane, are composed of the narrow edge of the same, are covered with a single layer of ciliated cylinder-epithelium, and bear within them a *single* vascular loop—at least I have never seen more than one, although Gerlach speaks of several vascular loops in the villi of the mucous layer of the membrana tympani. These loops arise from the vessels of the mucous tissue which underlies the mucous membrane, and is, at this time, as is easily to be understood, still extraordinarily increased in thickness. From the location at which the villi cease to appear, the mucous membrane continues to bear for some distance a wavy and almost papilla-like appearance, although I have never been able to demonstrate vessels or loops of vessels, even in injected specimens, in any of these papilla-like prominences, which, like the villi, are also covered with a ciliated cylinder-epithelium.

Further investigations must show whether the occurrence

of these villi is constant, or whether they are only present in the foetus and new-born children, and then disappear after respiration has become well established, just in the same way as the underlying mucous tissue of the *labyrinthine wall*.

Explanation of the Figure.

Cross-section at the upper third of the handle of the hammer through the membrana tympani, adjacent wall of the external auditory meatus, and the mucous membrane of the inner tympanic wall in a four-months' foetus; injected from the abdominal artery. Hartnack, eye-piece 3, system 4, no tube.

p, papillæ of the cutis of the external auditory meatus, which cease close to the membrana tympani.

t, membrana tympani with a few vessels in the cuticular layer and mucous layer, a few of these being empty, the others filled with the injected substance. A large oval vascular cavity lies just at the boundary line between the *Mt* and the mucous membrane of the internal tympanic wall.

z, the villi (a few with an injected vascular loop) resting upon the mucous tissue, which exhibits a large number of vascular cavities.

ON THE STRUCTURE OF AURAL POLYPI.

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THE study of aural polypi is of great and interesting assistance to us in our investigations into the nature and origin of tumors in general, because in cases of polypus of the ear we have the most favorable opportunities of examining them in all stages of their growth. In a word, the cause of their origin and the manner of their development lie clear before our eyes. Although Moos and Steinbrügge have lately published a long and interesting paper upon this same subject,¹ yet I see no reason why I should not again offer for the consideration of the profession another long series of examinations of polypi, and so much the more reasonably as I am able to append the clinical history of almost every case.

The great majority of aural polypi spring from the soil afforded by a suppurative inflammation of the middle ear in the shape of small round granulations, which possess all of the histological peculiarities of the common kind of wound granulations; exceptionally, however, they exhibit an epithelium which often takes an enormous share in the growth of the polypus. If we examine aural polypi of older growth we see again, just as in granulations after wounds or incisions, that, even when the granulation-tissue is still present, there are various mixed forms, intermediate between true granulation-tissue and mature connective tissue. The older the polypus the greater the amount of con-

¹ These ARCHIVES, vol. xi., p. 328.

nective tissue. Nevertheless, even in the oldest polypi we discover clumps and clusters of round cells, particularly in the periphery. If the middle ear is entirely free from sup-puration at the time of examination we can frequently demonstrate the presence of some equally sufficient local irritation, such as a foreign body which presses upon the walls of the auditory meatus, or a plug of cerumen which has remained for a long period within the meatus, or has been pushed even deeper in or down upon the membrana tympani by the patient himself.

Hence, I think myself justified in asserting, from the microscopic as well as the clinical picture, *that almost all aural polypi are originally nothing but granulation-tumors*, whose fate it is to be ultimately transformed into connective tissue. For this reason I shall all the more carefully describe as a whole, and in the closer details, the microscopic condition of all the aural polypi that I have so far seen. Only a few of the polypi attain, however, any considerable size, and undergo the above described transformation. For, leaving aside the large number of polypi which are operatively removed at an early date, others are by no means infrequently spontaneously exfoliated by the accidental rupture of the pedicle, especially when it is fragile, as we frequently see a polypus dislodged from the meatus by a single syringeful of water, though gently applied. Then, again, many polypi do not appear to have any tendency to increase in size after attaining certain dimensions. Sometimes, also, spontaneous involution takes place when the exciting cause has been removed, a fact of which we shall surely be convinced after removing sequestra which have become imbedded in polypoid proliferations. This process can be aided and supported by the alcohol treatment, and by antiseptics. The chief reason why we so rarely meet with large aural polypi with mature tissues is that the processes of nutrition within the polypus have in some manner been disturbed or absolutely prevented. Thus, in most polypi, even in those that are still minute, we may find partial degeneration of the tissues, and, as a cause for the same, extensive alterations in the vessels.

The chief histological characteristic of aural polypi is the preponderance of granulation-tissue: large round cells with large nuclei and innumerable nucleoli lying within a delicate alveolar frame-work. These cells lie close together without any considerable amount of intermediate substance. The older polypi exhibit in addition regular rows of nuclei like these, mingled with spindle-shaped cells and more or less mature connective tissue; the older the polypus the more abundant the connective tissue. The transformation of connective tissue begins chiefly in the axis of the tumor, from the root outward. Round cells are in most cases found in the periphery. The external layers of young polypi, especially, exhibit smaller round cells lying together in pairs or triplets, or even in larger numbers, or else large ovoid, elongated cells, constricted in the middle, suggesting to the observer the peripheral growth of the polypus by segmentation of cells. Alongside of these normal cells, however, the tissue is often found in a very degenerated condition. We observe, amongst other changes, a more or less extensive œdema with increase of the intermediate substance, a dust-like opacity of the same tissue, and myxomatous degeneration. The nuclei themselves are swollen to such a degree and are so opaque that the nucleoli can no longer be recognized. Moreover, we frequently find hemorrhagic infarctus with its sequences, in which the alveolar frame-work is still preserved and filled with red corpuscles, or deposits of pigment cells, which in this case are mostly taken up by the round cells. Giant-cells are also generally visible amidst incipient degenerative changes like these.

The cause of all these occurrences is to be sought for alone in the blood-vessels, which in the youngest polypi form a thick network of capillaries, precisely as in simple granulations. The larger vessels have either very thin walls, in which case they are extremely varicose, or enormously thickened walls which occasionally exhibit hyaline degeneration. Besides this, many of the vessels are filled with thrombi. Three of the polypi that I examined consisted almost entirely of vessels and cavernous spaces (angioma).

Only two thirds of all aural polypi possess an epithelium.

Those which have no such external covering, are usually small roundish tumors with a smooth surface composed of a thicker tissue. It is difficult to decide whether the epithelial layer was only destroyed at a later date by the corroding influence of the secretion (a circumstance frequently observed in other parts of the body), or whether the tumor sprang from a region which had previously been deprived of its epithelium. Whenever the epithelium is found upon the polypus, it corresponds of course to the epithelium of the soil from which the polypus arose, so that polypi which spring originally from the tympanic cavity are covered in the beginning at least, with a layer of cylinder-epithelium, while those that spring from the meatus are covered with a layer of pavement-epithelium. There will of course be exceptions in the case of polypi of greater than the average size, for, on the one hand, in some of those which without any doubt must have originated in the tympanum we find that the base alone is covered for a greater or less extent with cylinder-epithelium, while the summit is provided with pavement-epithelium. Between these varieties we find occasionally a cubical epithelium with one or more layers. On the other hand, I have found a large number of polypi whose roots, after removal of the tumor itself, were seen growing within the limits of the external meatus (although indeed at its inmost end), but which were partially and, in some instances, completely covered with a cylinder-epithelium. It is possible in these cases, in contradistinction to those previously mentioned, that the pavement-epithelium was transformed into cylinder-epithelium, which we may perhaps interpret by suggesting that the cylindrical basal layer was all that remained of the pavement-epithelium. Still, no other observations on this point have yet been published. I have not seen upon any of the polypi under notice a pavement-epithelium with vibrating cilia. The polypi which spring from the cuticular layer of the *Mt* are characterized by the long palisade-shaped processes of the rete Malpighi, sinking deeply into the fundamental tissue, as well as by the broad band-shaped fibres of the tunica propria, as V. Tröltsch first described

them. The numerous furrows and papillæ on the surface of the polypi cause us to find in many of the sections moderately deep indentations into the substance of the tumor, while further in we see round cavities lined with cylinder-epithelium, which former observers used to describe as the glands of polypi. I have never been able to discover any indentations which could accurately be compared to a tubular gland, and I think that the explanation just offered suffices for all of these appearances. When these folds and papillæ lie close to one another, the epithelial layer at the point of contact is gradually destroyed by pressure, so that the walls insensibly and mutually coalesce. In the bottom of the furrow, which is generally somewhat spacious, the epithelium is still preserved intact, and a genuine, strangulated, round, gland-like cavity is thus formed, lined with cylinder-epithelium, or filled with a pearl of epidermis. Transudation frequently takes place into this cavity; the transudate coagulates and the epithelium is gradually destroyed. In many cases, however, we find remnants of the epithelium that have been preserved, and it is by these that we can easily determine the correct significance of these cavities. The sheaths of the hair bulbs also frequently appear to be the starting points for circumscribed proliferations, for in polypi I have often found imbedded larger or smaller pearls of epidermis and cholesteatoma, sections of which exhibited bits of hair and long fissure-like spaces which probably had contained cholesterine crystals—the latter having dissolved in the alcohol. The most interesting of all the polypi was one which consisted only of proliferated sebaceous glands with slight supporting tissue (adenoma).

Before describing the various polypi and giving a brief abstract of the clinical history of the cases, I have one or two additional remarks to make.

All of the polypi which were not dislodged by the force of the current from the syringe were removed with Wilde's snare. One polypus only was crushed off with the surgical forceps. The after-treatment consisted in cauterization of the stump with argentic nitrate fused upon the end of a

probe, or with chromic acid in crystals, and when the hemorrhage was excessive, by sopping the stump with a solution of ferric perchloride. The boric-acid treatment, as suggested by Dr. Bezold in 1878, was then persisted in until all supuration had entirely ceased. Further, I would state that where I have mentioned the dimensions of the polypi, I had only before me those tumors which had lain, perhaps for years, in alcohol, and were as a matter of course enormously shrivelled, while the dimensions given in the clinical histories were discovered directly after the removal of the tumor. Finally, I would remark that the watch, with which tests of hearing were made in many of the cases, could be heard normally at four feet.

In order to compare the polypi more satisfactorily with one another, I have arranged them according to the clinical picture. First, those which sprang up during the course of an *otitis media purulenta ACUTA* upon the *Mt* and in the *auditory meatus*, generally during the period of observation. These consequently exhibit the earliest stages of development. Secondly, those which were discovered in the tympanum or on the *Mt* and in the meatus during *otitis media suppurativa CHRONICA*, in which class those with simultaneous perforation of Shrapnell's membrane are arranged by themselves, on account of the peculiarity of the process there involved. Finally we have those polypi which originated in the external auditory meatus from any given local irritation.

FORMATION OF POLYPI IN:

I.—*Otitis media purulenta acuta.*

a : On the membrana tympani.

CASE I.—Mr. F., æt. fifty-nine. February 16, 1880. Otorrhœa, left ear, four weeks; began with violent pain. Watch = 0. The air douche presses pus out from a flat tumor on the posterior half of the *Mt*; no perforation-whistle, yet watch is at once heard on contact. Profuse suppuration lasts for two months despite antiseptic treatment. April 11th, the tumor was snared off; a fortnight later pain, tenderness, and swelling over the mastoid region. Pressure on the most sensitive spot forces an abundance of pus out from the meatus. Wilde's incision, and a sound passed 3.2

cm. into the opening. No distinct communication with the tympanum. The fluid in the incision-track pulsates freely. May 10th, suppuration from the meatus has ceased, and that in the incision is trifling. The perforation in the *Mt* soon healed over, and the opening behind the ear completely closed by May 27th. The hearing was subsequently improved, by use of catheter, to watch, 2" and by December to 5."

The polypus is as large as the head of a pin, covered with pointed papillæ and a thin layer of pavement-epithelium, and consists of minute round cells lying in a peculiar alveolar tissue. The intermediate substance, thickened at the periphery, is opaque as if dusted over; vessels scarce.

CASE 2.—Mr. F., æt. forty-seven. April 25, 1880. Four weeks ago violent pain in the head and previously healthy right ear; discharge ever since. Mastoid process sensitive to the touch. Right: hearing, loud voice, 3". Perforation-whistle. *Mt* apparently bulged forward polypus-like in its upper portion. The left meatus shows an exostosis just over the short process and directly in front of the *Mt*. Watch at 2." April 27th, polypus on the *Mt* removed. May 5th, having re-appeared it is again snared off. During this time continuous pain in the mastoid. June 24th, a third polypus removed from the same position, and its base cauterized with chromic acid in substance. The discharge ceased by July 4th. The perforation in *Mt* closed over, and by August 1st, hearing was 3" for a whisper.

One of the three polypi only was examined. It shows an enormously thick pavement-epithelium, closely compressed round cells with a few spindle-shaped cells; vessels difficult to find.

CASE 3.—Mr. H., æt. forty-two. May 3, 1881.—Unilateral acute suppuration of the middle ear; polypus in the posterior superior quadrant of the *Mt* removed and the base cauterized with liquor ferri. Frequent paracentesis necessary to prevent too rapid closure. June 12th, the suppuration has ceased and the *Mt* is permanently closed; watch, 2½".

Small polypus with very thick pavement-epithelium composed of extremely degenerated and œdematous granulation-tissue. Some of the few blood-vessels show thrombosis.

CASE 4.—Anna R., æt. five, totally deaf in both ears; discharge without pain for seven weeks following scarlatina and diphtheria. Both meatuses filled with polypi; November 16th, polypi removed

from both sides ; total loss of *Mt*. Treatment was declined ; patient neglected, and returned after several months with fetid suppuration in both ears ; no relapse of the polypi. The suppuration ceased under the boric-acid and iodoform treatment ; deaf-mutism.

Medium-sized polypus with thick pavement-epithelium, large round cells, and interspersed with numerous wide lymph-spaces.

CASE 5.—Mr. T., æt. twenty-nine. February 10, 1883. Acute suppuration of the left ear for five weeks, with fever and pain in head ; suppuration very profuse and extremely offensive ; hearing, low voice, 10 *cm.* ; perforation sound ; pain on pressure on the mastoid. The seat of the *Mt* is occupied by a broad polypus ; removed on March 2d. By March 8th a new polypus made its appearance in the same spot and was snared off. The same on March 17th, 24th, and April 15th. The suppuration continued till June 30th, when the perforation closed, and low voice could be heard at 1 *m.* July 15th, hearing 1½ *m.* The *Mt* appears normal.

Flat polypus as large as a pea, without epithelium ; consists of round cells with increased opaque intermediate substance, numerous blood-vessels, and cavernous base.

b : In the external meatus.

CASE 6.—Mr. K., æt. forty-three. February 10, 1881. Acute middle-ear suppuration for a fortnight. The meatus is so narrow that the *Mt* can scarcely be seen. Suppuration profuse but inodorous. Hearing, low voice, 40 *cm.* The suppuration persists despite boric-acid treatment. A polypus on the posterior wall of the meatus is snared off. The suppuration ceases July 9th ; *Mt* closed over ; whisper, 5 *m.* ; watch, 10 *cm.*

The polypus is flat, has a broad base, no epithelium, is made up of degenerated round cells transformed into clods, in which we can no longer recognize the nuclei ; numerous vessels with very thick walls and many thrombi ; hemorrhagic infarcti.

CASE 7.—Mr. P., æt. twenty-eight. February 5, 1882. Deafness in the right ear since infancy. Six weeks ago pain in right ear, followed by profuse otorrhœa ; intense pain in the head. The cartilaginous meatus is filled with a polypus covered with epidermis, the removal of which is accompanied with a gritting sound. The stump is cauterized with liquor ferri. Total deafness, right. The orifice was slightly dilated with laminaria bougies.

The polypus is ovoid, as large as a pea, and has a broad base. It is composed of pavement-epithelium, with enormous development of the rete Malpighi, a few round cells with nuclei, and near the base some connective tissue. Vessels scanty, though the root is very vascular.

c : Within Wilde's incision.

CASE 8.—Acute granulations in Wilde's incision.

Kidney-shaped polypus 1 *cm.* long, without epithelium, composed of round cells, numerous vessels, several of which contain thrombi, at which places the intermediate substance is increased and opaque. Occasionally a few spindle-shaped cells.

II.—Otitis media purulenta chronica.

1.—Simple.

a : Polypi of the tympanum.

CASE 9.—Master H., æt. fourteen. June 14, 1883. Otorrhœa, right side, for two months; at first with pain. Three weeks ago the mother noticed something growing from the meatus; this is snared off under chloroform, the base touched with liquor ferri. The root lay on the floor of the tympanum. July 27th, both ears dry; right ear, large perforation of *Mt*, the round window visible in profile. A small granulation is still present in the tympanum, but it does not secrete; perforation sound.

The polypus is as large as a bean, without epithelium; round cells with œdematous intermediate substance. A broad band of spindle-shaped cells and mature connective tissue extends from the base of the polypus. Here also we find a large space filled with red blood corpuscles; also hemorrhages in the tissue.

CASE 10.—Miss W., æt. thirteen. July 17, 1883. Discharge from the left ear for four years, and repeated removal of polypi; cause scarlatina; suppuration with headache; July 18th, removal of polypus; July 21st, another portion resting upon the deepest part of the meatus and probably on the posterior wall of the tympanum was snared off; *Mt* absent; perforation-whistle. Up to September 2d suppuration had not returned.

Bean-sized polypus, with narrow vascular root and coarse lobules. Cylinder-epithelium at the base, pavement-epithelium elsewhere. The whole polypus is interspersed with hemorrhages, partly necrosed, and shows faint traces of connective tissue and round cells.

CASE 11.—Miss H., æt. twenty-two. March 28, 1883. Otorrhœa six years; right with perforation, left with polyp filling the entire meatus. Hearing, low voice, right 80 *cm.*, left 20 *cm.* Perforation sound on both sides. The polypus is snared off and the root, which rests in the tympanum, cauterized with chromic acid. Up to April 28th both tympanic cavities are dry. Hearing for low voice, 5 *m.* right ear, 2 *m.* left ear.

Polypus larger than a bean, with distinct root and deep furrows. On the bottom, cylinder-epithelium; on the summit, pavement-epithelium. Large vessels, imbedded in a wavy connective tissue, extend from the cavernous root to the summit of the polypus. Round cells lie just beneath the surface. Numerous and extensive hemorrhages.

CASE 12.—Mr. E., æt. twelve. April 8, 1878. Otorrhœa, five years, on both sides. Right ear, large tympanic polypus in the lower half of the tympanum; left ear, granulations upon the margin of the *Mt.*, and tympanic mucous membrane swollen. Hearing for low voice 2 to 3 *m.* on both sides. Perforation-whistle on both sides after Politzer's inflation. April 12th, polypus removed from the right ear; left ear, argentic nitrate in substance. April 24th, last visit, the discharge had entirely disappeared from both ears.

Flat polypus, in the shape of half an egg, $\frac{3}{4}$ *cm.* in length, $\frac{1}{2}$ *cm.* broad, 2 *mm.* thick, covered with fine papillæ, has cylinder-epithelium near the base and pavement at the summit, and is made up of round cells with a few vessels. Myxomatous degeneration at the base very extensive, with delicate net-shaped figures of coagulation, and a few spindle-shaped and star-shaped cells.

CASE 13.—Mr. G., æt. thirty-eight. June 10, 1879. Right ear, tympanic polypus filling the osseous meatus; suppuration for fifteen years. After snaring off we see that the root of the polypus passes further backward into the tympanum through a perforation which exists in the inferior half of the tympanum. The discharge ceased in a few days, and in the summer of 1880 it was still absent.

Polypus as large as a pea, with a rough surface, has cylinder-epithelium on the base and cubical epithelium on the body, and is made up of large swollen and partly pigmented round cells in which we can discover only a few nuclei. Vessels are scarce. Some portions have been transformed into myxomatous tissue, and exhibit star-shaped cells. Ripe connective tissue is visible at the base of the tumor, as well as the characteristic broad fibres of the

tunica propria of the *Mt*, so that it is probable that a part of the root of the polypus at least had originally started from the inner surface of the *Mt*.

CASE 14.—Miss K., æt. twenty-four. October 17, 1883. Chronic suppuration from the right ear for thirteen years; at times very fetid. Raspberry-like polypus in the osseous meatus arising from the posterior superior quadrant of the *Mt*, as is evident after its removal. The *Mt* is apparently preserved *in toto*, yet is united with the inner wall of the tympanum. The posterior margin of the former perforation stands free in front of the narrow root which arises from near the stapes. Tinnitus is perceived on cauterizing the root with argentic nitrate. No perforation sound. The patient did not remain for perfect cure.

The polypus is as large as a split pea, looks like a wart, is covered at its base with cylinder-epithelium, higher up with a many-layered cubic epithelium, and is composed chiefly of round cells, although mature connective tissue, myxomatous tissue, and transition stages are also visible. The vessels are few; larger or smaller cavities empty or filled with amorphous contents and lined with flat cells—probably lymph spaces.

CASE 15.—Mrs. W., æt. thirty-seven. March 17, 1880. Discharge from both ears since youth; polypus in the right osseous meatus; left ear shows the remains of chronic suppuration.

Long round polypus, with cylinder-epithelium and vibrating cilia at the base, cubical epithelium at the summit. It is composed of round cells with numerous vessels, near the larger of which is some slightly œdematous connective tissue. There are also some cavities partly lined with cylinder-epithelium, and partly, instead of the latter, filled with amorphous contents, the latter evidently indentations in the epithelium which have been cut off, and followed by secondary degeneration of the epithelial cells.

CASE 16.—Mr. R., æt. twenty-eight. June 18, 1879. Occasional otorrhœa since youth. In 1872 he suffered for a long time and almost daily from violent attacks of vertigo with tendency to vomiting. The discharge was at that time dark and continuous. He has had renewed discharge, vertigo, and headache for six weeks. The inner half of the left meatus is filled with a polypus which is snared off three times in succession. The root lies in the tympanum. Total destruction of *Mt*; suppuration soon ceases.

Three bean-like tumors, one of which is examined. It has

cylinder-epithelium on its base, but the largest part of the surface is covered with pavement-epithelium, and is composed chiefly of mature connective tissue with myxomatous patches. Round cells scattered here and there on the surface and in the interior ; a few vessels.

CASE 17.—Dr. S., æt. twenty-seven. Suppuration of left ear for three years. Polypi have been repeatedly removed by other otologists ; one apparently filling the whole meatus is snared off at once. The suppuration ceased in a few days and has remained so since. *Mt* almost destroyed.

Large oval polypus with a thick pavement-epithelium, which has pushed long, narrow prolongations into the polypus. The polypus is composed of very large, round cells, with numerous vessels full of thrombi. A thick cord of broad-fibred connective tissue with long, narrow nuclei extends from the base outward. The connective tissue is almost mature. The whole tissue shows excessive degeneration as well as numerous hemorrhages.

CASE 18.—Mrs. H., æt. twenty-five, January 4, 1882. Otorrhœa on both sides since infancy. Left ear : a polypus extends about 1 *cm.* beyond the meatus, and is red and glittering. No pain, vertigo, or tinnitus. The use of the snare meets with great resistance on the part of the polypus. Hearing, low voice, $\frac{1}{4}$ '. January 7th, the remainder is snared off, and the rest syringed out. The base of the polypus lies in the tympanum ; perforation of *Mt*, down and in ; perforation-whistle. January 12th, suppuration has ceased ; hearing, low voice, 3'.

Polypus 2 *cm.* long and $\frac{3}{4}$ *cm.* thick, covered with small papillæ. At the base cylinder-epithelium, further up pavement-epithelium. Granulation-tissue, which in the middle is œdematous, and under the surface gives way to numerous narrow fibres of connective tissue ; wide vessels with thin walls.

CASE 19.—Mr. M., æt. nineteen. July 3, 1879. Chronic suppuration in both ears since childhood. Last evening profuse hemorrhage from the left ear. A dirty blackish polypus deep in the meatus, and completely filling it, is snared off. Watch, on contact. Inco-stapedial joint visible in the perforation ; *Mt* has united with the long arm of the anvil, but on being separated by the curved needle, watch is heard at one inch and a half. August 3d, watch at two and a half inches. The secretion has ceased.

Polypus, as large as a cherry, with villi on the base. No epithelium; its place occupied by coarse fibres and increased accumulation of cells. *The body of the tumor consists wholly of wide and narrow vessels with thin walls, while between them lie cavities filled with red blood corpuscles.* The vessels are extremely wide at the base, and decrease in size toward the summit where they are extremely fine. Round cells predominate, and are interspersed with a few giant-cells.

CASE 20.—Master H., æt. fourteen. September 14, 1883. Chronic suppuration for five years with polypus, fetor, occasional hemorrhage, but no pain. Polypus removed. Hearing, low voice, 10 cm.; no perforation-whistle. The polypus sprang from the posterior wall of tympanum. *Mt* shows sickle-shaped perforation in the upper quadrant, through which can be seen the promontory covered with granulations. The handle of the hammer is apparently necrotic, and is removed despite adhesions. September 24th, the suppuration has ceased. The *Mt* appears as if the handle of the hammer were still in position, but this arises probably from the cartilaginous portion of the hammer having remained behind; most of the mucous membrane of the tympanum has been transformed into epidermis. Hearing, low voice, 10 cm.; after insufflation of pulverized boric acid, hearing, 30 cm.

Polypus: pure granulation tumor, the size of a pea, consisting only of round cells with large vessels.

The handle of the hammer can be easily cut without previous decalcification; cross-sections are perfect. It is covered with pavement-epithelium, but its osseous substance has been replaced by connective tissue rich in cells, containing hemorrhagic and myxomatous patches. A few bits of cartilage are still recognizable.

CASE 21.—Mr. R., æt. forty-two. May 7, 1878. Right-ear polypus in the meatus, probably emerging through a perforation in *Mt*, due to too energetic syringing ten years before. Profuse suppuration for four years. After snaring, watch on contact (?). May 19th, a second polypus snared off. July 4th, the discharge has ceased; hearing, watch, 1 inch.

The first polypus is about 1 cm. in length, very slender and with a club-shaped end. Most of the surface shows cylinder-epithelium; at the end, cubical epithelium. A band of connective tissue with large vessels, embraced by a thick covering of round cells, passes entirely through the axis of the polypus.

The second polypus is round, the size of a split pea ; cylinder-epithelium, round cells, and many large vessels.

CASE 22.—Miss R., æt. twenty-four. July 6, 1876. The patient accidentally dropped some muriatic acid into her ear, five years ago. Suppuration, two years ago; persistent pain for six months. Since then continuous otorrhœa. Tuning-fork is heard in this ear (*which ear?*—TRANS.) at one inch. Polypus springing from the tympanum snared off. The base is touched with liquor ferri. Perforation-whistle. Injected fluid runs through the nose—at a later visit there was no discharge.

Of the bits of polypus, one is about 1 *cm.* in length, covered at the base with villi and composed of round cells with varicose vessels ; most of the surface is covered with cylinder-epithelium with vibrating cilia ; at the summit, cubical epithelium. Œdema and hemorrhagic infarctus. The second portion is oblong ; base has pavement-epithelium ; round cells abound, mixed with spindle-shaped cells and mature connective tissue.

CASE 23.—Miss K., æt. twenty-four. October 1, 1883. Chronic otorrhœa *after scarlatina* at the age of six. Discharge more profuse for two months. *The syringe dislodges* a pea-like polypus with slight hemorrhage, apparently from the upper part of the tympanum. October 6th, no discharge ; perforation-whistle.

Polypus : no epithelium ; round cells, which on the periphery are small and degenerated. At the base, giant-cells. In the centre, several large vessels ; all the rest are small.

CASE 24.—Caroline R., æt. three. Jan. 25, 1881. Otorrhœa one year, left side, *after scarlatina*. Polypus on promontory. The ear had been syringed for months with carbolic-acid lotions. Snaring.

Round tumor without epithelium, very vascular, particularly in the middle. The component round cells are degenerated in the margin of polypus.

CASE 25.—Master V., æt. fourteen. October 13, 1876. Chronic otorrhœa and perforation of *Mt* on both sides for six years, subsequent to *scarlatina*. The polypi originate close to the *Mt*, and perhaps in the tympanum. Hearing, low voice, both ears, 2 *m.* October 14th. Polypi in the right ear removed ; hearing increased to 5 *m.* Argentic nitrate to base. Up to December 20th no discharge.

Small lobulated polypus : on the base cylinder-epithelium,

further up pavement-epithelium ; round cells. At the periphery, the intercellular substance is increased ; a few spindle-shaped cells.

CASE 26.—Master A., æt. ten. Six years ago *scarlatina*, followed by continuous otorrhœa on both sides. In the right meatus, a polypus $2\frac{5}{10}$ cm. long. Snare. Liquor ferri.

One of the large fragments was examined ; ciliated epithelium, then cubical, and lastly pavement-epithelium. Myxomatous connective tissue everywhere except directly beneath the surface, where spindle-shaped and round cells are present. Large, thin-walled vessels at the base. Numerous large cavities partly lined with cylindrical epithelium, partly enclosing fragments of the same or amorphous contents, or even quite empty, so that we assume that all originated in the same way, viz., by folding in of the epithelium.

CASE 27.—Anna, æt. five. May 18, 1881. *Scarlatina* a year and nine months ago, followed by offensive otorrhœa, left, ever since. Deep in the meatus a soft polypus. Snared off. Chromic acid. The suppuration ceased at once.

Semi-globular polypus the size of a pea ; pavement-epithelium, pushing its palisade-like processes into the tissue, composed of large round cells with a few varicose vessels.

CASE 28.—Master H., æt. fourteen. June 30, 1879. Eight years ago *diphtheritis*, followed by otorrhœa left side. Polypus removed *with the syringe*. Discharge cured.

Cherry-sized polypus : no epithelium ; round cells, traversed by spindle-shaped cells in all directions. Hyaline degeneration of the vascular walls.

CASE 29.—Mrs. H., æt. nineteen. November 17, 1881. For four years repeated otorrhœa, right side. One year ago repeated hemorrhages. During the last few weeks occasional pain for a day or two at a time. Hearing, low voice, three inches. Polypus snared from the *Mt* or the promontory, followed by remission of pain. A small polypus still remains. November 19th. Violent headache last night. Syringe removes cheesy fragments and clumps of epidermis. November 20th. The small polypus snared off. No perforation-whistle. December 7th. Discharge has ceased, posterior half of *Mt* destroyed ; mucous membrane of the tympanic walls transformed into epidermis. A small perforation above the short process is surrounded by a margin of epidermis, which was

the situation of the second polypus. Hearing, low voice, four inches. December 28th, no discharge. Hearing, low voice, eight inches.

Both polypi are composed of closely aggregated round cells, with numerous large vessels; no epithelium; giant-cells in the larger polypus.

CASE 30.—*Polypus dislodged after using the syringe*, probably from the middle ear.

Small tumor without epithelium, degenerated round cells, abundant pigmentation, and a few wide vessels. A few giant-cells at the base.

CASE 31.—Master G., æt. fifteen; April 12, 1882. Chronic otorrhœa, left side, since infancy; a polypus had been removed two years before. A new polypus now projects beyond the orifice of the meatus, and is removed at several sessions. Result unknown.

Large polypus: no epithelium, a few spindle-shaped cells in the middle, and mature connective tissue—especially at the base. Surrounding the whole, a mantle of round cells; numerous hemorrhages and extensive degeneration; a few small vessels.

CASE 32.—Fanny, æt. five. Chronic otorrhœa, left side. Repeated snaring off of polypi; once a polypus *was dislodged with the syringe*. No constitutional affection, despite acute local inflammatory symptoms. The child died several months later, at the General Hospital, with cerebral symptoms.

Autopsy.—Cholesteatoma in the tympanum and antrum, rupture of tegmen tympani, meningitis, and cerebral abscess.

Polypus as large as a bean, coarsely lobulated, thin pavement-epithelium, round cells, and numerous vessels, a part of which show thromboses. Occasional spindle cells and mature connective tissue.

CASE 33.—Polypus removed with common surgical forceps.

Polypus as large as a hazel-nut, with coarse lobes, and a pavement-epithelium with extraordinary development of the rete Malpighi. Fibrillar, wavy connective tissue, with spindle-shaped and scattered, large round or oval nuclei—easily distinguished from the cells of the granulation-tissue. Beneath the surface, groups of round cells and a few myxomatous patches. Furthermore, large cavities, partly empty, partly lined with cylinder-epithelium, originating as before suggested. Small vessels, with thickened walls and numerous thrombi.

b: Polypi of the membrana tympani.

CASE 34.—Mr. M., æt. thirty-three. March 29, 1882. Otorrhœa from both sides occasionally since childhood; lower half of *Mt* absent. The polypus in the right ear appeared to rest upon the short process and handle of the hammer, for a gritting sound was perceived as the snare tightened, and a bare patch of bone could be felt with the probe. Slight hemorrhage; argentic nitrate. Hearing for low voice: right, one foot; left, eighteen inches. Perforation-whistle on both sides. May 19th, hearing for low voice: right, eight feet; left, six feet. Discharge ceased.

Round polypus: no epithelium; round cells with few vessels; giant-cells. Laterally the sections show a semicircular piece of bone (handle of hammer), with large medullary cavity, cartilaginous envelope and remains of the *Mt*.

CASE 35.—Master W., æt. nine. November 23, 1879. Otorrhœa since dentition; in March last, pain in left ear and abscess behind the auricle, demanding the use of the knife. Extensive perforations of both *Mt*. Continuous suppuration, with occasional hemorrhage. Polypus partly destroyed with galvano-cautery, but suppuration continues.

The first polypus has no epithelium; composed of round cells, many segmented at the periphery, arranged in rows, and mingled with spindle-shaped cells. Most of the vessels have thick walls; a few have thrombi.

The second polypus envelops the entire handle of the hammer, after removal of which the following condition is discovered: thick epithelium with long processes; connective tissue interspersed with round cells; broad ribbon-like fibres of the tunica propria of the *Mt*, and a portion of the cartilage of the handle of the hammer.

CASE 36.—Master K., æt. nine. December 31, 1883. Five years ago, diphtheria, followed by chronic otorrhœa, left side, with polypus on *Mt*; profuse discharge running down on shoulder. Tuning-fork by aerial conduction; low voice at 5 cm. *Mt* covered with a polypus, which is snared off January 5th, bringing with it the entire hammer, partially necrosed. Hearing, 20 cm. January 10th, the rest of the polypus is removed. The fetid suppuration still persists to this day, despite the frequent irrigation, the use of astringents and antiseptics—boric acid, peroxide of hydrogen, and a five-per-cent. solution of carbolic acid. *A few*

tubercle bacilli discovered in the aural secretion, but there are no demonstrable defects in the lungs as yet.

A polypus with a triangular piece of bone in its centre. The perichondrium extends in to the tunica propria of the *Mt*, and then into the tissue of the polypus, where it finally disappears. The tumor consists of round cells, thick pavement-epithelium, and extensive rete Malpighi sending long prolongations into the tissue of the polypus.

CASE 37.—Miss K., æt. twenty-one. *Scarlatina* twelve years ago, and persistent otorrhœa on both sides ever since. Small polypi around the perforation in right *Mt*. Left ear, a polypus lying on the floor of the osseus meatus; snared off. The tumor rests on the margin of the opening in the *Mt*, and arises from the *Mt* itself.

Polypus: $\frac{1}{2}$ cm. long, $\frac{1}{4}$ cm. thick. The cylindrical-epithelium at the base soon changes into cubical. Round cells pushed aside occasionally by the intermediate substance. Spindle-shaped cells and a little mature connective tissue.

CASE 38.—Mrs. H., æt. forty-two. October 17, 1883. Otorrhœa, left side, for *forty-one years*, with tumor on the perforation-margin of *Mt*. Hearing for low voice, 30 cm. *The injection dislodges* a small, pale polypus; *Mt* almost entirely absent. November 16th, discharge has ceased.

Polypus: no epithelium, large round cells, numerous vessels with very thick walls and thrombi. Yellowish pigment, partly enclosed in round cells and partly free in the tissue; a few giant-cells.

CASE 39.—Miss W., æt. twenty-nine. September 10, 1881. Suppuration for nine months, after repeated deafness. Left ear: Perforation of *Mt*, filled with a pale, small tumor, not protruding much beyond the level of the perforation, but which can be moved with the probe, when we discover that it is attached to the posterior periphery of the perforation. Snare; suppuration ceases. Hearing: Watch, right ear, two inches; left, five.

Round polypus: pavement-epithelium, here and there thicker than usual; closely aggregated round cells, with perivascular connective tissue. The cortical layer is œdematous and myxomatous; pigment in the round cells; a few vessels in the middle; in the margin, delicate capillary net-work.

CASE 40.—Mr. N., æt. sixteen. April 24, 1881. Chronic otor-

rhœa, right side. Polypus arising from the posterior margin of *Mt*; snared off. Liquor ferri. Hearing: low voice, one foot and a half. April 27th, discharge ceased, and remained so at last visit in July.

Bean-sized polypus, with small lobes; pavement-epithelium, with long processes. Round cells, with large amount of connective tissue. A few very large and very thin-walled vessels.

CASE 41.—Mr. R., æt. twenty. March 22, 1882. Otorrhœa, both sides, since age of three. A bean-shaped polypus removed from margin of perforation in *Mt*. Perforation-whistle. The supuration ceased April 13th.

Long round polypus; pavement-epithelium, with the long, thin processes characteristic of those polypi which spring from the *Mt*. Large round cells, with fibres of mature connective tissue and spindle-shaped cells. Numerous vessels.

CASE 42.—Miss S., æt. fourteen. November 21, 1883. For three months, occasional pain in left ear, fetid discharge. Perforation-whistle. Large polypus, deep in the meatus, springing either from the edge of the perforation, or from the tympanum. After this is removed a second comes to light beneath it, and is snared off. Anterior half of *Mt* lost, the rest is grayish-red and shiny. Small granulations on the inferior margin of *Mt*. Secretion still present, the case remaining under treatment.

The larger polypus: pavement-epithelium, and rete Malpighi penetrating deeply into the tissue; filled almost sieve-like with large round, thin-walled cavities, in which are red blood corpuscles (*teleangiectasis*). Broad ribbon-shaped connective-tissue fibres like those in the *Mt*, abundantly interspersed with round cells.

The second polypus is composed chiefly of pavement-epithelium, with long palisade-like processes. Round cells and smaller vascular cavities as in the first polypus.

CASE 43.—Miss H., æt. fourteen. August 4, 1881. Otorrhœa, right side, since *diphtheria* five years ago. Polypi removed from the posterior superior margin of *Mt*. Perforation-sound; hearing for low voice, three feet. August 13th, the discharge has ceased.

Cherry-sized polypus without epithelium. In the centre large, in the periphery minute, round cells, with giant-cells. Extensive hemorrhages, and partial destruction of the tissue.

CASE 44.—Miss R., æt. eleven. Otorrhœa, left side, three years,

Polypus removed with snare, but the discharge does not cease, despite boric acid, alcohol, and sodic-benzoate.

Large, long, round polypus, with pavement-epithelium, the rete Malpighi of which penetrates deeply into the tissue of the tumor. Round cells and spindle-shaped cells. Additionally a piece of the tunica propria of the *Mt*, upon which the tumor rested, has grown into the latter. Mature connective tissue and a few large vessels.

CASE 45.—Miss W., æt. seven. May 29, 1879. Chronic myringitis, right side, with granulations on the surface of the *Mt*, the result of chronic otorrhœa. Perforation-whistle. Removal of the tumor; discharge ceases August 9th.

Two of the granulations have no epithelium, but exhibit on their surfaces accumulations of fibrin and red blood corpuscles. The smaller polypus consists of degenerated round cells. Incipient connective-tissue transformation and numerous hemorrhagic infarcti, and remains of the same.

The larger polypus is composed of round cells, abundant pigment, and giant-cells.

CASE 46.—Miss Z., æt. thirty-one. October 30, 1883. Otorrhœa, both sides, chronic; the right meatus so narrow that nothing can be seen. Boric-acid treatment, followed by enlargement of meatus, and granulations visible on the *Mt*. November 8th, a small polypus removed from the *Mt*. November 13th, discharge has ceased.

Small round polypus, without epithelium, composed of round cells and numerous vessels.

c: Polypi in the meatus.

CASE 47.—Mr. H., æt. forty-five. September 19, 1881. Otorrhœa, right side, twenty-one years. A polypus is removed from meatus with a gritting sound. *Mt* and handle of hammer almost entirely destroyed. Tympanum full of pale granulations. Hearing absent. No vertigo. Perforation-whistle.

Polypus $2\frac{1}{2}$ cm. long, 1 cm. thick, ninepin-shaped, with narrow root. Cylindrical epithelium, with vibrating cilia, passing over into cubical epithelium. The axis of the polypus exhibits an œdematous and hemorrhagic condition, with round cells. Numerous large cavities, with amorphous contents or homogeneous or stratified fibrin, with a few nuclei and some cylinder-epithelium. Others are lined throughout with cylinder-epithelium. The root contains large thin-walled vessels. Similar ones run in the axis of the polypus.

CASE 48.—Mr. W., æt. twenty-five. March 11, 1884. Disagreeable discharge from the right ear for fifteen years. Lately, repeated hemorrhages. A large blackish-red polypus, filling the entire meatus, is removed, and discovered to have started deep down in the meatus. A few granulations also present. No perforation-sound. March 21st, discharge reduced to a minimum; tympanic mucous membrane visible; promontory granulated. Above, the short process is just visible.

Cherry-shaped polypus, without epithelium, *consists entirely of large vessels and intervening cavernous spaces, all of which are entirely filled with red blood-corpuscles.* Around the whole are strewn some round cells, and at the base a moderate number of giant-cells.

CASE 49.—Mrs. H., æt. thirty-two. April 2, 1876. Polypi of tympanum on each side; removed. April 15, 1877, she appears once more with a polypus in the right ear, which causes headache, vertigo, and loss of memory. Snared off. Root lies at the deepest part of the meatus. The *Mt* is intact, but the handle is invisible. Watch, on contact; after inflation, four inches.

Polypus has a thin layer of epithelium, and contains small round cells, with numerous thin-walled vessels.

The smaller polypus is round, has a thin layer of epithelium at the summit, cylinder-epithelium at the vascular base, and is composed of round cells and large vessels.

CASE 50.—Mr. A., æt. twenty-two, June 11, 1883. Uninterrupted otorrhœa, left side, since infancy. Headaches frequent, and feeling of fulness in head. A polypus was removed a year ago. The meatus is now blocked up with a large polypus; removed at two sessions; springs from the end of the meatus. Hearing for low voice, 10 *cm.* June 12th, repeated snaring; liquor ferri. June 17th, snaring. The discharge now gradually decreased under boric acid and iodoform treatment.

A bit 2 *cm.* long and 1 *cm.* thick is examined; cylinder-epithelium at base, pavement-epithelium at summit. Round cells, with a few large vessels. Concentric fibres of connective tissue, and myxomatous patches.

CASE 51.—Mr. L., æt. twenty-one. March 27, 1883. Fetid discharge from right ear for eight years, but no pain; perforation-whistle. A polypus filling the meatus is snared off; liquor ferri. Hearing, watch, 10 *cm.*; low voice, 5 *m.* March 31st, the stump is again cauterized with chromic acid. May 8th, discharge has

ceased ; no perforation can be seen. Siegle's pneumatic speculum moves the entire *Mt* outward. Hearing for low voice, $4\frac{1}{2}$ m.

Bean-sized polypus, with rough surface, composed of two parts united with a pedicle ; cylinder-epithelium at the base, pavement at the summit, wavy connective tissue interspersed with round cells. Coarse net-work of normal connective tissue interspersed with myxomatous and necrotic tissue. At the periphery, well-preserved round cells, wide, thin-walled vessels ; hemorrhagic infarctus.

CASE 52.—Mr. P., æt. fifty-one. November 2, 1883. Double otorrhœa since childhood ; right ear, polypus ; left ear, perforation of *Mt*. Polypus snared off at three sittings ; liquor ferri. Deafness, left side, for several years ; hearing in right ear variable. Large polypus in the meatus snared off. November 4th, fibrinous exudation has formed on the stump. November 7th, stump still swollen, but no discharge. November 8th, stump shrunken. November 12th, discharge ceases. Persistent perforation of *Mt* ; hearing for loud voice, 12 cm.

Polypus : cylinder-epithelium at base, pavement at summit ; composed of œdematous granulation-tissue, with numerous vessels, a number of which contain thrombi.

CASE 53.—Master U., æt. fifteen. November 16, 1882. Otorrhœa, both sides, since childhood ; polypus, right side, at age of four and eight, violent pain in right ear. Renewal of pain for a fortnight past ; facial paralysis for three days. Left, a large perforation. Right, loud voice, indistinctly ; left, low voice 50 cm. Snaring. November 25th, renewed snaring.

Very large polypus with pavement-epithelium, round cells highly degenerated, arranged in rows. Vessels numerous and containing thrombi ; a few giant-cells.

CASE 54.—Mrs. F., æt. fifty-three. May 22, 1883. Otorrhœa right side, for thirty-one years. Polypus in the meatus, perforation-whistle ; low voice doubtfully heard even close to ear, tuning-fork by ærial conduction. Frequent headache, inability to think, and weak memory. Discharge fetid. Snare. On the following day dizziness after injection, as used to be the case. May 27th, snared again. June 12th, discharge has ceased.

Oblong polypus, 1 cm., coarsely granulated surface with cylinder- and pavement-epithelium. Round cells and connective tissue, also large cavities with amorphous contents. Vessels few.

CASE 55.—Mr. K., æt. twenty-four. November 13, 1882. Otor-

rhœa, right side, *since scarlatina* at the age of five. Large polypus filling the meatus, snared off several times. Liquor ferri. November 15th, fibrinous exudate in the meatus washed away with syringe. November 28th, no discharge.

Cylindrical and cubical epithelium; œdematous granulation-tissue with numerous vessels, which, just beneath the surface, form a regular net-work.

CASE 56.—Mr. H., æt. forty-three. December 8, 1876. Otorrhœa, three months, right side. Latterly pulling and roaring in the ear, Polypus snared off. Watch, one inch. December 20th, watch, three inches.

Kidney-shaped polypus 1 *cm.* long; no epithelium, and composed of closely packed, large round cells which frequently show degeneration and pigmentation. Numerous vessels with thick walls and many thrombi. Many cavities which contain an alveolar frame-work and a few nuclei, probably the remains of hemorrhagic infarctus. Small cord of connective tissue in the axis of the polypus.

CASE 57.—Mrs. G., æt. forty. July 11, 1881. From childhood to age of twenty, otorrhœa, right side; spontaneous removal of polypus. Suppuration in last five years. Large polypus in meatus, frequent headache. Hearing for loud voice three inches. Snaring and profuse hemorrhage. January 10, 1882, discharge has ceased.

Bean-shaped polypus with cylinder-epithelium at base, pavement-epithelium above. Composed of connective tissue with a few groups of round cells. At one end, extensive coagulated masses of a yellow color, in which round cells lie arranged in rows. Hemorrhagic infarctus, and cavities as in other tumors previously described.

CASE 58.—Mr. R., æt. forty-one. October 9, 1883. Has heard badly with left ear since youth. For twenty-six years has had otorrhœa on this side, and since last April pain. In May a polypus was removed; severe pain followed. For four days left facial paralysis; mastoid process sensitive to pressure; polypus in the meatus; deafness for tuning-fork by aerial conduction; right ear, normal hearing. Removal of polypus with complete relief to the patient, necrosed bone at root. October 13th, removal of polypus again. October 30th, the operation repeated, and again on November 3d, at which time three sequestra were removed,

evidently portions of the cochlea. November 4th, the rest of the polypus snared off. November 26th, the meatus is clean.

The polypus first removed is as large as a cherry, with thick epithelium, and composed chiefly of round cells, broad connective tissue at the base, vessels of narrow calibre with thickened walls.

The polypus removed November 3d is small, without epithelium and with numerous wide vessels.

The last polypus is as large as a pea, without epithelium, and consists of round cells and innumerable large vessels with intermediate deposits of pigment.

CASE 59.—Mr. S., æt. thirty-two. September 5, 1881. Otorrhœa for years on one side, from which a large polypus was removed several years ago. At present a large polypus fills the meatus ; snared off and the suppuration ceases.

The polypus is oblong and has no epithelium. The stroma, composed of round cells and connective tissue, contains, in connective tissue capsules, several enormous acinous glands with distinct excretory ducts, in which we see fatty particles and around which the various acini cling. Close to the glands are bits of hair, and at one spot there is a pearl of epidermis lying across the cross-section of a hair.

2.—With perforation of Shrapnell's membrane.

CASE 60.—Mr. G., æt. thirty-eight. July 18, 1877. Suppuration from left ear for four months. No pain. Right *Mt* concave. The left meatus is filled with a polypus springing from Shrapnell's membrane. Watch, on contact. Snared off, and touched base with liquor ferri. Two months later a second polypus removed from same place. January 18, 1879, no discharge ; opening over short process closed ; watch, on contact. June 12th, a small polypus snared off from the old locality.

First polypus the size of a cherry, round, no epithelium, round cells ; numerous vessels mostly with thrombi ; large groups of giant-cells, partially degenerated.

The second polypus resembles a hemp-seed ; flat with vascular base, no epithelium, granulation-tissue with numerous vessels.

The last polypus is as large as a pea, horny epithelium, round cells with a few vessels.

CASE 61.—Mr. H., æt. eighteen. August 8, 1878. Discharge from right meatus for eight months ; during the last two days pain in ear and head, increased upon pressure over mastoid. In the

narrow meatus a discolored polypus. Watch not heard from ear, but from mastoid and right forehead. No perforation-whistle. Polypus snared off twice, and base frequently cauterized with chromic acid in substance. The spot where the polypus rested appears to correspond to Shrapnell's membrane, and the curved sound can be pushed into a cavity leading upward. August 23d, cheesy masses syringed from the cavity. Watch, at one inch. December 23d, watch, four inches. Neck of hammer visible in perforation, but it does not feel rough.

Coarse polypus, $\frac{1}{2}$ cm. long, thick epithelium, round cells arranged in rows at the periphery, some of which are constricted in the middle preparatory to segmentation. Occasional spindle cells. Many of the numerous vessels contain thrombi, while near by the tissue is œdematous and degenerated or else interspersed with hemorrhagic infarcti.

CASE 62.—Mr. M., æt. thirty-five. October 5, 1882. Right facial paralysis five years ago, probably from exposure. Recovery rapid. Five weeks ago the same symptom, which is still present. Otorrhœa on the same side three weeks ago without pain. In the last ten days persistent vertigo and unsteadiness in walking, and for the last two days pain. Hearing for low voice, 5 cm. No perforation-whistle. Meatus filled with a polypus, which is snared off October 6th and October 14th; chromic acid in substance. November 4th, hearing for low voice, 3 m.; slight secretion, but no perforation. At Shrapnell's membrane irregular curvature. The facial paralysis and discharge soon disappeared; hearing for low voice, 4 m.

Hemp-seed granulation without epithelium, but with large vessels; composed entirely of round cells.

CASE 63.—Mr. P., æt. twenty-five. April 1, 1880. Otorrhœa, left, for years; right, for five weeks. A polypus is removed from Shrapnell's membrane; galvano-cautery. Discharge stops April 24th. Repeated relapses and removal of polypi. At present, no discharge; large perforation near Shrapnell's membrane.

Pea-sized, pyramidal, brown polypus, without epithelium; large degenerated round cells, numerous large vessels, with hemorrhagic infarctus. Centre of polypus formed of a broad band of connective tissue; near it several cavities containing cells, probably the remnants of hemorrhagic infarctus; many giant cells.

CASE 64.—Master F., æt. sixteen. June 16, 1880. Polypus near

Shrapnell's membrane and otorrhœa left side. Snared off July 23d, and discharge ceases. Hammer and anvil plainly visible in the perforation.

Hemp-seed polypus without epithelium, composed round cells, some degenerated, others at the periphery subdividing. Numerous large vessels. At one spot the root of a hair with the appertaining sebaceous follicle.

CASE 65.—Miss M., æt. twenty-three. Double otorrhœa since childhood. April 20th, 1883, a polypus, springing from Shrapnell's membrane, was dislodged *with the syringe*. July 6th, patient returns, with pain on left side and discharge from the previously dry perforation. *The syringe again removes* a small polypus from the same region. The handle of the hammer attached to the promontory. Hearing, for low voice, 3 *m.*, left. Suppuration ceased with removal of polypus.

Small polypus, without epithelium, round cells with many thick-walled vessels; clumps of pigment in tissue of polypus. Remains of hair follicles, sebaceous follicles, and pearls of epidermis. Giant-cells.

CASE 66.—Mrs. R., æt. twenty-six. May 8, 1883. Repeated polypi on Shrapnell's membrane. Has been subjected already to the alcohol treatment and galvano-cautery elsewhere. Within three weeks a new polypus has sprouted from the same position. Snared off. Discharge ceased in November. At present the *Mt* shows cicatricial contractions and folds. December, discharge has reappeared. January, 1884, a fresh polypus at the same locality; no perforation-sound. Operative removal of polypus as before. Hearing, low voice, 5 *cm.* Slight but inoffensive otorrhœa still continues.

Round polypus with excessively thick epithelium, composed of delicate myxomatous tissue, with a few round and spindle cells and numerous vessels.

Case 67.—Mr. S., æt. twenty-one. March 12, 1882. In January, four days of pain in left ear, followed by suppuration; polypus on Shrapnell's membrane. No perforation-sound; watch, at half an inch. Patient had been treated ten years before with argentic nitrate solution, probably for suppuration. Snared off the polypus. March 21st, otorrhœa ceases; May 24th, watch, at ten inches; July 27th, no discharge.

Round polypus with cylinder- and pavement-epithelium, at the

root only ; large degenerated round cells, small amount of connective tissue, numerous ectatic blood-vessels. Pigmentation here and there in the cells, and giant-cells.

CASE 68.—Master S., æt. nine. Suppuration followed by hemorrhage from the left ear for the last twelve days. Black shiny tumor, *removed with the syringe*. The *Mt* now appears as if sunken and attached to the inner wall of tympanum. Above the short process a small perforation, with irregular edges. No perforation-sound.

At the root of the polypus a thick mesh-work of connective-tissue fibres, from which radiate other delicate fibres toward the surface, where they unite and form a thicker envelope without epithelium, in absence of which the polypus is covered with thick clusters of micrococci. The interspaces of the mesh-work are without any endothelium and filled with red blood corpuscles.

CASE 69.—Miss Z., æt. thirty. January 8, 1881. Suppuration in left ear since September, with occasional hemorrhage. In August last white scaly masses were frequently removed from the meatus. A large polypus now fills the meatus, and after snaring off, its root is plainly visible near Shrapnell's membrane. Concentric and stratified layers of skin and epidermis repeatedly evacuated after snaring off the polypus. At last the meatus is clean, and a perforation in Shrapnell's membrane is visible. Discharge ceases ; hearing for watch, two inches.

Long, roundish tumor without epithelium, composed of extensively degenerated round cells, penetrated in all directions by connective-tissue fibres, numerous vessels (especially in the periphery), and a few giant-cells.

III.—Polypi after otitis externa.

CASE 70.—Mr. F., æt. twenty-one, April 15, 1876. Polypoid granulations on the floor of the left meatus after long-continued presence of a plug of cotton-wool. Watch, on contact. Snaring, April 30th ; no discharge ; watch, at eight inches.

Round polypus of 4 mm. diameter, without epithelium, composed chiefly of round cells with scattered hairs and pieces of epidermis. In the centre, a large piece of epidermis with an abundance of hairs. The same thing is visible toward the root.

CASE 71.—Mrs. W., æt. forty-two. July 18, 1883. Deaf for years ; plugs of cerumen in both ears, completely filling the meatus. Suppuration from the left ear for three days. *Injection*

with the syringe dislodges from the left ear a pea-sized, pale-red, round polypus arising from the bony meatus, but at some distance from the *Mt*; argentic nitrate to root. Both *Mt* whitish. Discharge ceases from left ear after removal of polypus. *Polypus produced by the pressure of a plug of cerumen.*

Polypus without epithelium, composed of excessively degenerated round cells and connective tissue; extensive hemorrhagic extravasations and necrosed tissue.

CASE 72.—Mr. D., æt. thirty-three. July 24, 1883. Plug of cerumen, which being removed, a small polypus with a narrow base is seen resting upon the deepest part of the posterior wall of the osseous meatus. Snared off.

Polypus is really a bit of epidermis, with concentric stratification and fissure cavities, in which cholesterine crystals were formerly situated; granules of pigment and drops of fat.

CASE 73.—*Wart from the tragus.* Bean-sized, coarsely ridged tumor, consisting chiefly of long epithelial cylinder, which extend inward from the pavement-epithelium covering the rough surface. Pearls of epidermis and very scanty supporting-tissue of connective-tissue fibres, with a few round cells and numerous vessels.

Review of the above material.

The cause of the polypi was otitis media purulenta acuta in eight cases: five of the polypi grew from the *Mt*, two from the meatus, and one from a Wilde's incision. None of these originated in the tympanum.

Otitis media purulenta chronica in sixty-one cases, in ten of which the polypus was located upon or near Shrapnell's membrane. Of the remaining fifty-one polypi, twenty-five sprang from the tympanic cavity, thirteen from the *Mt*, and thirteen from the external meatus. Besides these, there were four other cases in which polypi in the meatus arose independent of any suppuration, and chiefly, in our opinion, from the irritation caused by foreign bodies or plugs of cerumen.

Most of the patients were from twenty to thirty years of age. Ten were less than ten years of age, sixteen between ten and twenty, twenty-one between twenty and thirty, ten between thirty and forty, twelve between forty and sixty. Age unknown in four.

Forty-four of the seventy-three patients were men, twenty-seven women.

Histologically, thirty-three of the polypi were pure granulation-tumors, composed only of round cells and numerous vessels; twenty-three contained, additionally, some connective tissue; while in only eight polypi did mature connective tissue preponderate over the other elements. Five of the polypi were essentially vascular tumors; one a lymphangioma, one a teleangiectasia, and three cavernous angiomata, which are rare amongst aural polypi. In each of these three cases the entire tumor consisted of red blood corpuscles which lay enclosed in vessels and cavernous spaces. Consequently they bore externally a resemblance to dry clots of blood. Four of the polypi were epithelial tumors: amongst them a small cholesteatoma, which had evidently been produced in the meatus by the pressure of a plug of cerumen; a wart from the tragus; a wart-like growth from the cartilaginous meatus; and, finally, an adenoma. The last was found in a case of chronic otorrhœa, and it is interesting to see how, in this tumor, in a circumscribed space a number of sebaceous glands have enormously proliferated.

The tendency to degeneration in polypi is emphasized by our calling to attention the fact that this condition was marked in forty-six out of seventy-three polypi.

The three cases in which the handle of the hammer was partially or wholly inclosed are also very interesting. They confirm anew the assertion of Moos especially,¹ that it is often impossible to remove a polypus resting upon the handle of the hammer without removing the handle itself, but that at the same time the latter operation is not only not dangerous but often one of the very best steps that can be taken to abbreviate the morbid process. The myxomatous transformation of the bone of the handle of the hammer is also attractive, and reminds us of a similar case described by Hartmann in these ARCHIVES. I have never been able to discover new-formation of bone in any of the polypi that I have yet examined.

Finally, I would say that almost all of the polypi

¹ *Zeitschrift für Ohrenheilkunde*, Band viii.

were hardened in alcohol or in Müller's fluid, and then on account of their diminutive size, imbedded in paraffin, or between two pieces of liver, and then microtomed. These sections were then tinted with hæmatoxylin (the best and most rapid method of tinting), cleared up in oil of cloves, and preserved in Canada balsam. Some specimens were also tinted with borax-carmin, and a number with various aniline tints, which give beautiful pictures, but they fade in time to such a degree that they are less suitable for permanent preparations.

CONTRIBUTIONS TO THE PATHOLOGY AND PATHOLOGICAL ANATOMY OF THE EAR.

By A. HEDINGER, of STUTTGART.

Translated by WILLIAM RANKIN, Jr., M.D., Newark, N. J.

AS a sequel to the communications which appeared last year in this journal, the following contributions to pathology and the pathological anatomy of the organ of hearing may be of interest, chiefly because the history of the disease is followed up till death, and the result of the autopsy in both cases about to be described is remarkable and somewhat rare, but also on account of the inferences to be drawn from it as regards the advisability of opening the mastoid process and the choice of the place of operation.

I.—*Papilloma in the meatus, starting from the middle ear ; suppuration of the middle ear ; burrowing abscess in the neck ; stagnation of pus ; breaking through of the pus under the dura mater, and into one of the emissaria Santorini ; opening of the cells of the mastoid process ; chiselling off its apex ; death in consequence of œdema of the brain.*

Mrs. R., aged sixty-three, first consulted me in the year 1874, on account of a discharge from the right ear. At that time the examination showed a fibrous tumor filling up the greater part of the meatus, with a net-work of blood-vessels (like a cavernous tumor) on the surface ; the discharge was moderate. Of subjective symptoms, the only one present was a feeling of numbness of the right side of the neck and face. Hearing distance, 50 cm. (normal-acoumeter). As she did not wish to undergo an operation I heard nothing from her for years. She says that within the last two years pieces of the polypus have been several times removed

by a professional hand without preventing the recurrence of the tumor. The case stood thus when, in April, 1883, she sought admission to the Ludwig Hospital, on account of severe pains in the ear. Attending these were frequent hemorrhages from the ear. At the same time there was also a purulent discharge from the ear, which, however, within the last year, had been constantly decreasing.

For several weeks she has been under treatment for severe pain in the ear, at the back of the head, and in the temporal region. She says that three days ago a swelling of the whole right temporal region suddenly appeared, accompanied by febrile symptoms. For several years she has been almost totally deaf in the right ear.

Status præsens: In the region of the right temporal muscle the skin is somewhat reddened, and feels warmer than the surrounding parts; the whole region is swollen; on palpation, springy, elastic resistance; no distinct fluctuation. In the external auditory canal a whitish swelling is visible.

April 23d.—Incision through the apex of the swelling; offensive pus is discharged from an abscess cavity which is under the temporal muscle and extends as far as the zygomatic arch; two counter-incisions, one on a line with the zygoma, the other in front of the tragus; the first is made under guidance of a director, the other by successive division of the several layers. A branch of the temporal artery spirts and is tied. Three drainage tubes; cleansing with sublimate; iodoform on the drain openings; moist compresses (acetate of alumina).

April 24th.—Dressing saturated with blood and bad-smelling pus; change of dressing; pains have ceased; swelling slight.

April 25th.—Change of dressing; very offensive matter in the dressing and on syringing out the abscess cavity. Condition of patient good.

May 1st.—Daily change of dressing. Secretion continues foul. Swelling moderate. Appetite very good.

May 4th.—Dressing this morning completely saturated with blood. In the afternoon spontaneous hemorrhage from the anterior upper drain opening, which is arrested by digital compression.

May 5th.—In the evening the hemorrhage is renewed with change of dressing. Tamponing with Penghawar-Yambee.

May 6th.—Hemorrhage is not repeated. Patient somewhat weakened.

May 8th.—Removal of the tampon, which is saturated with pus and smells badly.

May 17th.—Strength good ; no real progress towards healing perceptible in the wound.

Patient has complained for several days of pain in the cheek opposite the first molar, where a hardness is perceptible. The swelling becomes softer and projects toward the cavity of the mouth.

Incision of abscess from without. After cutting through the skin a blunt-pointed conductor is forced into a pus cavity which is connected with the original one, and out of which about twenty grms. of foul pus is discharged. A large drainage tube is passed in from below through the entire length of the abscess cavity to the upper incision.

Evening : condition of patient good, no pain.

May 20th.—Daily change of dressing. The pus has not yet quite lost its foul odor.

May 25th.—The drainage tube is cut in two and the two pieces somewhat shortened. General condition good.

June 8th.—Patient complains of pain in a circumscribed spot in the middle of the right sterno-cleido-mastoid. Skin on this side somewhat reddened, slightly bulged forward by a hard tumor, the size of a button, situated around and in the muscle.

June 12th.—Pain and swelling increased along the inferior half of the sterno-cleido-mastoid.

June 19th.—Operation. Skin is cut above the middle of the sterno-cleido-mastoid, and a probe pushed into an abscess cavity lying in the sheath of the muscle. Discharge of about thirty grms. of not quite odorless pus. Counter-opening in the region of the sternal insertion of the muscle. From here a long, large drainage tube is passed upward behind the muscle ; a short one is put in the upper incision. Cleansed with sublimate ; moist dressing.

June 20th.—For the first time in eight days again free from pain ; slept through the night.

June 24th.—Condition continues favorable.

June 30th.—Daily change of dressing. No alteration ; drainage tube gradually shortened ; secretion moderately great ; odorless.

July 13th.—General condition every way favorable, no pain, no fever, moderately great odorless discharge. Patient is discharged with four drainage tubes of medium size—one in the inferior

insertion of the sterno-cleido-mastoid, one in the middle, one behind the ear in the region of the mastoid process, one in front of the tragus ; she is dressed daily at her home.

Re-admitted October 30th.

The fistulas in the neck and in the temporal region, one after another, had gradually healed in the course of the last month. The condition of the patient had been good, with the exception of pain felt from time to time in the right linea occipitalis. According to those who had been with her she staggered somewhat in walking. About three weeks ago the pains returned in an aggravated degree, interrupted only by short intervals of relief. At the same time a large swelling appeared in this region ; the patient lost sleep. The appetite remained good and with it also the appearance and strength of the patient. There has been no fever.

Present condition : At the right linea occipitalis on the posterior part of the mastoid process and behind it is a diffuse swelling, offering upon superficial pressure jelly-like resistance, on deeper pressure firmer resistance like swollen bone ; it is extremely painful spontaneously, but especially on pressure. The pains radiate towards the right temporal and parietal region, also in a lesser degree towards the neck. No fever ; pulse strong, not especially frequent. Appearance good.

Therapeutics : For the present, expectant measures ; ice-bag upon the painful parts with favorable effect, pain somewhat less, but still so severe that sleep is rendered possible only by morphia (0.01). This condition continues two weeks without material change ; constant, usually not very intense pain ; from time to time, particularly at night, more violent exacerbations. Upon consultation with Dr. Burkhardt we decided to make a perforation in the mastoid process. The operation was made by Dr. B. In the first place, on the posterior part of the mastoid process an incision was made about six *cm.* long through the soft parts to the bone. The soft parts were œdematous, macerated, broken down ; in the old scar a small abscess extending to the neighborhood of the periosteum. After forcing back the periosteum the mastoid process was opened with a chisel from behind ; the spongy tissue somewhat softer than normal, very vascular, the marrow much reddened. Nothing unusual about the exposed mastoid cells, particularly nowhere pus. Therefore second incision was made three *cm.* in front of the former one, running downward into it.

The mastoid process opened with the chisel in the usual place. When the opening was about one *cm.* deep the blood showed a purulent admixture; after further enlargement of the opening in the bone about ten grms. of whitish pus escaped from the bone with distinct pulsation. In order to keep the wound in the bone accessible to the eye a part of the flap was cut off. Small quantity of iodoform on the wound; wet compress of borico-salicylic acid.

November 3d.—Patient has slept quietly the greater part of the night and apart from slight burning pain in the wound has no more pain; feels as if "new-born." Change of dressing. The flesh wound and bone cavity cleansed with solution of sublimate. No reaction in the visible part of the wound, the dressing impregnated with blood and pus.

November 4th.—The past night was not so good; the old pain returned, but with less intensity; the patient has slept but little (no morphia).

This morning the pain is almost gone again. Daily change of dressing.

November 5th.—Not entirely free from pain. Change of dressing. The region of the posterior incision more swollen. On pressure pus was discharged from the interstices between the stitches; the sutures were removed, and a narrow drainage tube introduced. Almost a tablespoonful of pus was removed from this region by syringing. The wound begins to close with unclean granulations.

November 6th.—In the dressing a greater quantity of pus, corresponding for the most part to the posterior drainage tube. A larger tube introduced. Change of dressing in the evening.

November 7th.—Change of dressing morning and evening. Great discharge from the depth of the wound and from the posterior drainage tube. The granulations begin to cleanse themselves.

November 8th.—Very profuse discharge. Condition of patient during the last days variable, never quite free from pain. For two days she has seemed somewhat drowsy, and has been delirious at night. To-day the sopor is also distinctly marked in the daytime; the speech is somewhat inarticulate. Closer examination shows very slight contraction of the right pupil as compared with the left, and less reaction to light. On the right side, in the posterior-inferior region coarse bronchial râles. No recognizable dullness on percussion.

November 9th.—Change of dressing morning and evening as during the last days ; discharge still profuse ; sopor increasing ; the voice is hoarse to-day.

November 10th.—Discharge less in the evening, but still considerable ; sopor somewhat less ; patient complains of pain in the right half of the frontal bone ; pupils as above ; bronchitis on both sides, especially on the right.

November 12th.—Discharge again greater ; patient in heavy stupor ; groans a great deal.

November 14th.—Discharge somewhat abated ; consciousness sometimes slightly clearer, never entirely clear ; involuntary evacuation of the bowels.

November 15th.—Total loss of consciousness ; several times to-day clonic spasms of the left lower extremity ; in the evening tonic spasms of the left upper and lower extremities.

November 15th.—Respiration very frequent ; pulse somewhat intermittent ; well-marked facial paresis of the left side.

November 17th.—Death in deeply soporous condition.

Autopsy.—The right side of the neck from the mastoid region down to the neighborhood of the sterno-clavicular articulation diffusely swollen. At the upper border of the swelling two vertical incisions, from two to six *cm.* in length, running parallel with each other ; the posterior one corresponding with the posterior margin of the mastoid process, the anterior lying close behind the auricle. Protruding from these are several large drainage tubes, out of which, when the swelling is pressed, dirty yellow pus is emptied. When cut open it is seen that the swelling corresponds to a large abscess, much sinuated, which, beginning above at the side of the skull in the neighborhood of the mastoid process, extends along the course of the great vessels down the neck as far as the sterno-clavicular articulation. From the mastoid process it extends in the form of a sinus about three *cm.* broad, from six to seven *cm.* further backwards in a horizontal direction. This, like the whole abscess, has irregular, thickly infiltrated walls, and the periosteum of the mastoid, of the temporal bone, and of the adjoining part of the occipital bone is also especially involved in this thickening. Along the suture between these two bones, for one and a half *cm.* above and below the foramen emissarium, the bone is exposed and rough. Three *cm.* further backwards is a second rough place on the occipital bone ; also several more such places are seen still further backward. There is nothing abnormal about the roof of the skull or the soft parts covering it.

On opening the cranial cavity the dura mater is seen to be very tense, the superior longitudinal sinus is empty in front, and behind it contains a loose fibrinous coagulum. The pia mater of the convexity is very œdematous and moderately hyperæmic; the pia mater of the base, especially in the neighborhood of the chiasma, is much infiltrated with serum; in the ventricles, which are not enlarged, considerable clear fluid; nothing unusual about the ependyma. Substance of the brain normal, moderately hyperæmic. Over the right tegmen tympani several delicate connective-tissue bands pass from the dura mater over to the pia mater, otherwise the inner surface of the dura mater is at the base as well as everywhere smooth, lustrous, not injected. Sinuses at the base normal, with the exception of the right sigmoid sinus, which, from the point where it turns from the transverse sinus, seems to be entirely obliterated, together with the bulb of the jugular vein and the vein which passes outward through the foramen emissarium mastoideum. Just at this point the dura mater, which elsewhere can be readily peeled off from the base of the skull, is firmly adherent to the bone; after the forcible removal of the dura mater, a hole is disclosed in the temporal bone.

Heart of normal size, in its right half a large fibrinous coagulum. Lungs moderately hyperæmic, œdematous; nothing appears abnormal except an old fibrous cicatrix in the apex of the right lung. Spleen, kidneys, and intestine normal. Gall-bladder doubled in size, contains considerable albumen-like fluid. In Haister's valve is wedged a dark-green cylindrical stone five *cm.* long, one and a half *cm.* in diameter. Capsule of the liver, especially in the neighborhood of the gall-bladder, much thickened. Liver tissue, stomach, and intestinal canal normal.

From the interior wall of the external auditory meatus projects a tumor the size of a bean,¹ closing the entire opening; behind it the meatus is enlarged and filled with pus, and, as the membrana tympani is wanting, its posterior part with the tympanic cavity forms a large cavity filled with pus, in which only the ankylosed plate of the stapes is still visible. The entrance to the mastoid cells leads into the contracted antrum mastoideum, which is filled with pus. The Eustachian tube is much enlarged and filled with pus up to its pharyngeal mouth. A broad canal, the upper wall of which consists of the tense dura mater, leads from the antrum into a cavity the size of a cherry in the fossa sigmoidea (eleven *mm.*

¹ The microscopical examination of the tumor showed the characteristics of a wart (papilloma) with brownish pigment.

long, ten *mm.* broad). The edges of this cavity appear cariously eroded, and are thickly covered with an hypertrophied mucous membrane one *mm.* in breadth, which extends to the upper opening of the cavity. In the lower part of this cavity is another hole five *mm.* in diameter, with which the opening made by the operation, or which perhaps existed beforehand, communicates. From the same cavity a broad canal leads toward the antrum, over which in several spots are defects the size of a pea or less. Another carious passage, following the course of the emissarium Santorini leads into the incisura mastoid. (a frequent point of perforation according to Bezold, with which my own experience fully conforms), which for a distance of about twenty *mm.* presents a carious condition. Around this point, over a space the size of a two-mark piece, the bone is macerated, and at one point there is even a deficiency in the bone the size of a pea, excepting the lamina vitrea, in which the perforation is only the size of an apple-seed. This deficiency is without doubt the effect of a subperiosteal process.

The pus had consequently made for itself the following outlets:

1. Outwardly; the natural way through the meatus was obstructed by the tumor filling it; it flowed off therefore into the wide Eustachian tube, which was filled with pus up to the cartilaginous portion. Part of the pus could, after the vein became thrombosed, pass out of the cavity backward through the incisura Santorini and form the several burrowing abscesses in the neck which were successively opened. Therefore actual eruption of the pus through the dura mater did not anywhere take place.

2. To break through the superior wall of the antrum and the tense dura mater over it was also impossible, therefore it sought to penetrate inward, and in this way caused the excavation under the pyramid, of the size of a cherry, and the destruction of the bony wall of the transverse sinus.

3. Another outlet of the antrum went toward the opposite side, under the dura mater, where the bone is perforated to the size of a small pea on the external side of the petrous bone, at the junction of the posterior and middle thirds of the insertion of the temporal bone in the petrous bone (temporal suture), at the end of the middle cranial fossa.

Here, too, the dura mater was not damaged. The greater part of the pus emptied itself out of the carious cavity into the antrum by means of a wide canal.

4. The most posterior openings which are connected with the abscesses in the soft parts are also upon carious, eroded bone; the soft parts themselves are greatly infiltrated and hypertrophied. The highest opening probably broke at last inward through the tabula vitrea at a small biscuit-shaped place (therefore the very great hyperæmia and infiltration here), but without giving vent to a noteworthy amount of pus, because after the operation this could be discharged outward.

The portion of the jugular vein descending at a right angle above the foramen lacerum (which was covered with hypertrophied soft parts), *i. e.*, the bulbus jugularis, contains a thrombus. (The opening was made from the meatus auditorius internus.) The carotid is intact. The promontory is covered with very hypertrophied mucous membrane. Plate of stapes anchylosed. The utriculus normal. The semicircular canals also apparently normal. Cochlea normal. Dura mater everywhere easily detached, except at the places corresponding to the occiput.

Remarks.—If we enquire into the cause of death in this case, which lasted nearly twenty years, and in which the suppuration of the middle ear was accompanied by frequent retention of pus, by polypi, burrowing abscesses, and other grave conditions, we find that it was œdema of the brain and its effects. The œdema is explained by the thrombus in the bulbus jugularis, by the swelling and infiltration of the soft parts lying beneath the dura mater, and also by the intense and extended hyperæmia in the occipital fossa, where a spontaneous perforation of the cranium had occurred only a short time ago. No discharge of pus worth mentioning took place inward, because after the operation it could empty itself outwards. For the same reason the result would not have been changed had a transverse incision been made from the point of operation backwards, in order to give vent directly to the pus here, *i. e.*, to connect the old incision with the new. This is proved by the

decrease in the great infiltration, the swelling and redness of the skin in the region of the occiput a few hours after the operation, which also explains the unusual euphoria and the almost immediate freedom from pain.

The œdema may perhaps be regarded also as an indication of chronic septicæmia, as the symptoms during the last days can be explained also in this way.

In regard to the method of the operation, I beg to remark further: At the operation the cells were first opened without finding pus (the usual incision behind the ear, *raspatorium*, etc.); the chiselling into the apex of the mastoid process met with as little success; whereupon the operator chiselled upward toward the antrum for a long time without finding pus. It was finally found very deep. It became evident at once that the pus did not come from the antrum, but from a cavity lying posterior to and above it, which from its depth must have been situated in the cranial cavity. Had the transverse sinus not been pushed aside by the capacious pus-cavity (a very exceptional occurrence, and in this case a very fortunate one), it would have been opened, and fatal consequences have been the result.

From this it will be seen how cautious one must be in perforating the mastoid process, and how rigidly the prescribed plan of operation must be adhered to (compare what follows)—*i. e.*, in the right angle, bounded above horizontally by the *linea temporalis*, which can be felt in almost every one behind the auricle at the apex of the highest convolution of the auricle, and whose other side is a line drawn downward through the *spina supra meatum*. If the perforation is made here, the antrum will always be found, yet we should never penetrate deeper than 20 *mm.*, if we would avoid entering the semicircular canals. Nor should we go beyond the *linea temporalis*, if we would avoid injury to the *dura mater* in the cranial cavity. The opening should not be made further back, as otherwise we shall strike the transverse sinus, which is here only 9 *mm.* distant. The best general rule that can be given is to chisel upward toward the posterior wall of the meatus, and never directly vertically backward, always bearing in mind the

axis of the meatus, which intersects the axis of the operation at an acute angle. We have especially to thank Bezold of Munich for these exact directions, which should be adhered to under all circumstances.

How difficult it often is to make this operation without causing serious injury, and how many variations there are in the course of the transverse sinus, every one knows who has operated on the cadaver, and not without cause have the authors who are most competent to speak on the subject, held that it is justified only by the *indicatio vitalis*.¹ As for myself, having for many years made a distinction between those cases suitable for perforation and those which are unsuitable, and having also had sometimes under treatment for a long time cases that had been discharged by other operators as "cured," I have often enough had opportunity to convince myself on the cadaver of the correctness of the assertion, which I have also expressed in various periodicals, that the only indication can be the *indicatio vitalis*.

And also in such a case I am for an entire separation of the two operations, which have not often enough been kept separate by surgeons, as they should be, because of the surgical anatomy and still more because of the hint which nature gives us in the *fistulæ* of the mastoid process, namely:

1. The opening of the cells of the mastoid process.
2. The opening of the antrum of the mastoid process.

It is well known that most of the fistulas of the bone originate at the above-described point, the spot where the antrum lies nearest to the surface, which is the only one suitable for the operation, *i. e.*, in the right angle formed by the *linea temporalis* and the *spina supra meatum*.

The opening of the cells of the mastoid process has nothing to do with the preceding operation. If one wishes to undertake this, the incision must be carried downward

¹ Pain alone, though of the most violent kind, furnishes no indication for the operation. This is proved by the cases, and I myself know one such, where a physician insisted upon an operation, and the operator at first declined to operate and desisted from proceeding further when pus could nowhere be found. Later it appeared that the patient was hysterical, and the pain continued after as before.

over the middle of the mastoid process, and then, after forcing aside the periosteum, the bone may be opened directly inward. This operation is indeed very rarely needed, and still more rare is the necessity of chiselling off the apex of mastoid process itself, which, as I have seen in many instances, is absolutely without effect. Bezold has indeed pointed out, and I myself have described a series of such cases (see Reports of Patients, 1880-1882¹), that a great many abscesses break through behind the mastoid process and in the incisura mastoid., and burrow in the deeper parts. It is then of course of no use to chisel away the apex of the mastoid process. It is self-evident that cases occur where abscesses in the soft parts, as in our case, indicate the point of operation, and then one has no other choice. For the rest, it should be emphasized that it is not always easy to diagnose suppuration in the mastoid process, for I have seen cases where every objective and subjective symptom was wanting and only time brought to light a swelling in the upper part of the neck; which, taken in connection with the previous ear trouble, made the diagnosis of a burrowing abscess tolerably certain. Sometimes these abscesses heal by absorption; at other times by discharging through an opening outwardly, and if they occur in connection with caries or necrosis of the mastoid process, they are attended by the formation of sequestra or the exfoliation of particles of bone.

The oftener and the longer one observes these natural cures the less frequently will one make up his mind to make an operation which in the more severe cases is always accompanied by a certain degree of risk, and which in the lighter is not necessary and unnecessarily creates a large wound. We believe ourselves to be the more justified in this decision as modern surgery, notwithstanding its great and daring performances, is eminently conservative.

II.—*Chronic suppuration of the middle ear of both sides, with extension of the pus into the left cochlea and into the cranial cavity by means of the aquæductus vestibuli; abscess in the cerebellum; death.*

¹ Report of the Hospital for Diseases of the Ear in Stuttgart, by Dr. Hedinger. E. Koch, 1884.

Mrs. B.,¹ a peasant woman, fifty years old, has had for many years an otorrhœa of both sides, but has never as yet received proper treatment. The hearing power was always very much impaired, especially on the left side. According to her own statement the discharge has been much greater during the last four weeks, so that it appeared necessary to seek medical assistance. During the same time she has been suffering from a kind of whooping-cough, and has been complaining of vertigo and considerable uncertainty in walking. From this time also dates very violent permanent pain in the head, particularly in the occiput, which, especially in the last week, has increased at night so as to become intolerable. She also says that horribly smelling pus and mucus has exuded from the nose into the throat.

Present condition: The patient is a cachectic-looking, very emaciated, anæmic woman, who is hardly able to stand.

In the right ear is a firm polypus which reaches to the middle of the meatus and almost fills the canal; on forcing air through, some pus escapes by the side of it. After removal of two polypi with the snare, only a little pus is seen on the swollen promontory. Membrana tympani entirely gone. Hearing distance and bone-conduction = 0.

Left ear: membrana tympani also wanting; some coagulated pus lies upon the much swollen promontory; in the front part of the roof of the tympanum the probe strikes upon carious bone. There is total absence of ærial and bone-conduction. On inflation no pus was evacuated outwardly. Therefore no retention of pus exists.

Now, as the woman wished to be operated on, the question arose: Is there an indication for operative interference? Will perforation of the mastoid process have to be made eventually? Can benefit be expected from it, or does not the patient's condition of strength rather forbid for the present any great interference? As I had to answer the last question affirmatively, I postponed every thing for the present and confined myself to conservative therapeutics, mitigating the intense pain, especially at night, by narcotics and poultices, which gave her some relief. The vertigo as well as the weakness increased, however, and the patient, who took no nourishment, slumbered most of the time until the third day after her admission, when she became comatose. Pulse slow, feeble. Temperature not increased, rather lowered.

¹ An accurate history of the disease, unfortunately, could not be obtained.

Pupils somewhat contracted ; reaction normal. Patient continued in this condition for two days longer, and died in the night following without again becoming conscious. Marked symptoms of meningitis were absent.

Autopsy.—The body is very anæmic and wasted. On opening the cranial cavity attention was at once attracted to the intense hyperæmia of the veins of all the meninges. No thrombus in the transverse sinus of either side. The superior petrosal sinus is also empty. The dura mater is nowhere firmly adherent except in the region of the cerebellum ; at the posterior part of the pyramid of the petrous bone, in the posterior cranial fossa, it is firmly adherent to the bone and thickened, so that it can be removed only with force and in pieces. On the tentorium a very much thickened patch in the dura mater, presenting on its inner side an old cicatrix with irregular edges, which gives evidence of an earlier perforation ; it is covered with a brownish, greasy exudation. In the centre of the superior petrosal sinus is a small hole of the size of the head of a pin, directly over the vestibule, but which contains no pus. On the posterior surface corresponding to the cochlea and vestibule, and beginning at the superior petrosal sinus, the bone is snow-white over a space of the size of a fifty-pfennig piece, and by slightly corroded edges is separated from the remaining, very much reddened petrous bone. (Beginning necrosis.) The line of demarcation had progressed more outwardly than inwardly, and ceased directly beneath the internal auditory meatus. The consistent pus found there came out of the *acquæductus vestibuli*.

On the removal of the dura mater, near the superior petrosal sinus, is seen a thrombosed vessel of the thickness of a silk thread, which can be drawn one *cm.* out of the bone.

On lifting up the hemispheres of the cerebrum, and cutting through the chiasma, on this and to the side of it, floating around free in the middle cranial fossa, appears about a half a coffee-spoonful of discolored flocculent pus, evidently of old origin, which can be traced into the canal of the medulla oblongata. Also in the left posterior cranial

fossa, where the cerebellum rests upon the pyramid of the petrous bone, near the pons Varolii, is found an abscess of the size of a large walnut, containing dreadfully offensive pus. This presents a widely open cavity, with ragged and discolored edges, which is not completely filled, but, as it seems, has previously discharged a large part of its contents—although not long ago. The opening itself is broad, of the size of a small nut. The pia mater over the abscess is destroyed. The dura mater, at the point corresponding to this abscess, is much thickened—as already mentioned,—but nowhere is a perforation to be perceived. The previous existence of one can, however, still be clearly traced in the most thickened patch. In no other part of the dura mater can a perforation be discovered, but it is very decidedly hyperæmic, and, on the base of the cerebellum, very firmly adherent to the cranium.

Tuba entirely pervious, not filled with pus; bulbus jugularis without a thrombus.

After removal of the anterior wall of the external auditory canal, the anterior segment of the membrana tympani is found preserved, callous, and thickened, and adherent to the posterior wall of the tympanic cavity, leaving only a small part of the tube open; the mucous membrane of the remaining tympanic cavity is from two to three *mm.* thick, and covered with small granulations in the antrum. The antrum is very slightly developed, and its lining membrane is covered with cholesteatomatous scales. Had an opening been made, it would probably have struck the sinus. After removal of the mucous membrane of the posterior wall of the antrum, there is found, directly over the Fallopian canal, a triangular opening in the posterior half of the horizontal semicircular canal, of the size of a small lentil, filled with cheesy pus. By this opening a probe can easily pass into the vestibule, and from there on into the cochlea, also into the posterior part of the horizontal semicircular canal, which is laid open by the carious process.

A microscopical examination of the cochlea was unfortunately not possible, on account of the post-mortem changes in the preparation. It also contained pus.

The pus had, therefore, entered the cranial cavity during the purulent inflammation of the cochlea through the acquæductus vestibuli, at the spot corresponding to the beginning necrosis.

Remarks.—The following conditions are very remarkable:

1. Very little pus in the petrous bone, while in comparison considerable pus was found free in the cranial cavity, coming without doubt from the not long since ruptured abscess.

2. The absence of an opening in the dura mater can probably only be explained by the supposition that after a perforation and the emptying of pus had taken place in the direction of the cerebellum, the reactive inflammation closed the small opening by means of organized connective tissue. But the pus in the cerebellum caused wider and ever greater destruction, while no new influx came from without. Its discharge took place, on the contrary, through the bursting of the abscess at a later time underneath the dura mater, in the direction of the spinal canal. The coagulated pus, at the point of perforation, was, at any rate, of old date, and formed a sort of plug, a protection from within.

To recapitulate: there was present a purulent inflammation of the middle ear of the left side, involving the antrum, the vestibule, and the cochlea; and an extension of the morbid process to the cerebellum through the acquæductus vestibuli; and caries of the petrous bone.

The breaking through took place at a most unusual point,¹ namely, the acquæductus vestibuli. Usually it occurs at other points in the petrous bone; indeed, almost always.

That we could have effected nothing here by an operation, is a matter of course.

The cause of death was probably through long-continued, intense pain, want of sleep, loss of appetite. The pressure of the pus on the medulla oblongata cannot have been of enough significance, as œdema was nowhere present.

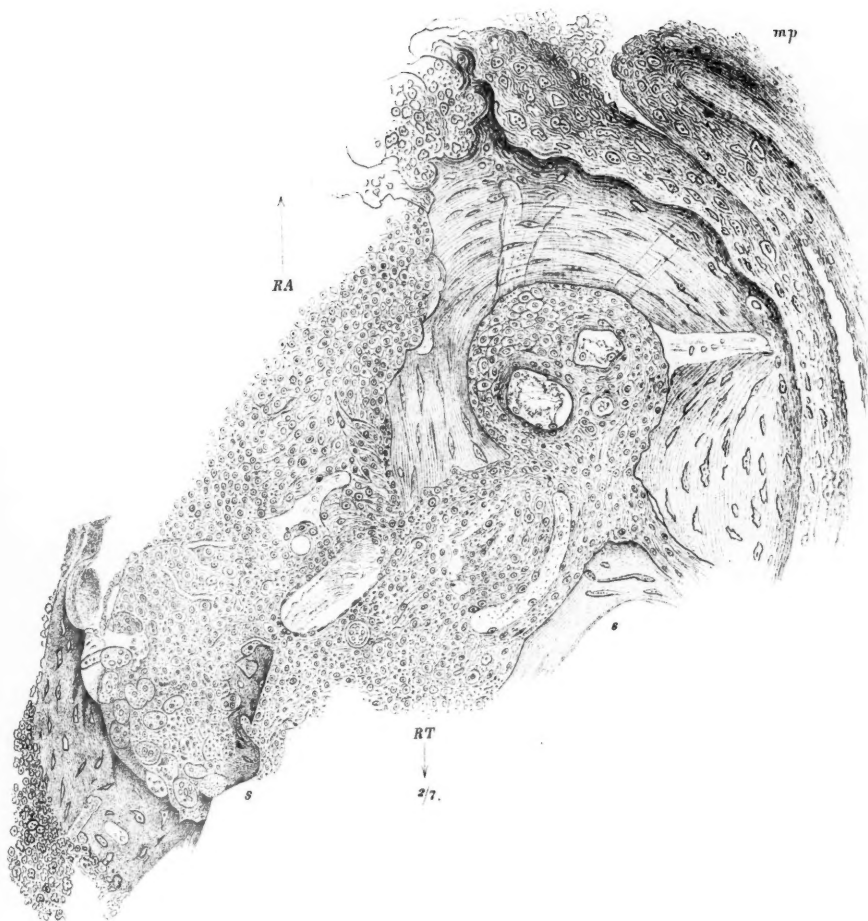
¹ According to Bezold's opinion, the tegmen tympani and the sulcus sigmoides are the most frequent points for the transmission of the purulent process; indeed, very often both serve simultaneously as conducting channels.

For the sake of comparison, I beg leave to refer very briefly to two counterparts, which I had the opportunity to see lately as specimens in the possession of Bezold in Munich and Rembold here. In the latter there are two carious perforations of the right petrous bone; one in the middle and one in the posterior cranial fossa. The first is on the upper surface, close to the upper edge, in the neighborhood of the tegmen tympani; the second on the posterior surface of the petrous bone, just above the point where the transverse sinus turns into the sigmoid sinus. Corresponding to both points there is at each a chronic abscess of the brain—the one in the temporal lobe, about the size of a hen's egg; the other in the cerebellum, nearly as large as a goose egg, involving nearly the whole hemisphere. The roof of the cavity of the latter is formed only of the thickened tentorium, which is closely adherent to the sides of the abscess, and is broken through at one small point, from which had developed an acute purulent basilar meningitis.

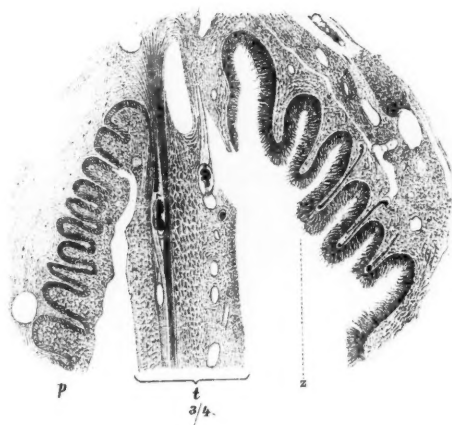
Such a breaking through from two sides, with formation of an abscess in the cerebellum, as well as in the cerebrum, is indeed a great rarity.

In Bezold's preparation a great part of the membrana tympani was intact (only its posterior upper part was adherent to the wall of the tympanic cavity, and here a polypoid granulation covered it), a perforation was visible in the region of Shrapnell's membrane, which led directly into a cheesy and cholesteatomatous mass in the entrance to the autrum and in the antrum itself. Discolored spots were found as well in the tegmen tympani as in the sulcus sigmoideus; the transverse sinus, the bulb of the jugular vein, and the internal jugular vein were filled with discolored thrombi. In this case death resulted from pyopneumothorax, as a sequence of pyæmic infarction of the lung.

I.



II.



Mosaic del.

Lith. Aust. v. C. Kört, Leipzig

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